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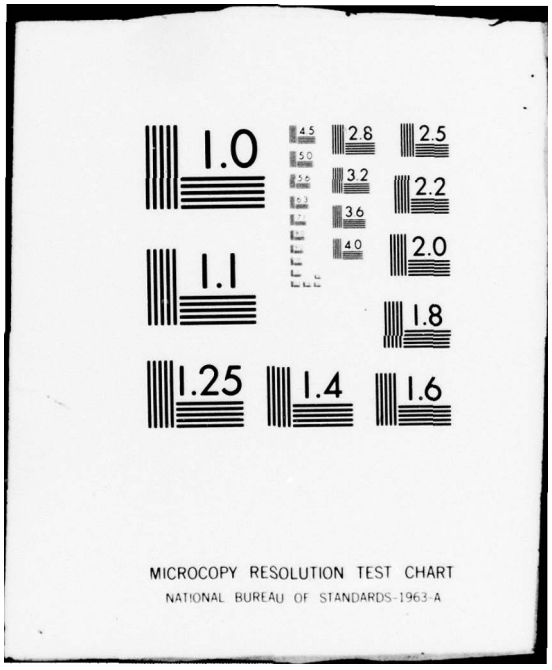
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U.S. ARMY METRICATION: ANALYSIS AND RECOMMENDATIONS FOR DA IMPLEMENTATION PLAN. VOLUME 2, ANNEXES

155 p.

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ANNEX A

U. S. TRADE STATISTICS, BY INDUSTRY

TOTAL SHIPMENTS, IMPORTS AND EXPORTS* BY INDUSTRY - 1975

Industry	Total Shipments ($ Millions)	Imports ($ Millions)	Imports (% of Total)	Exports ($ Millions)	Exports (% of Total)
TOTAL NEW CONSTRUCTION	123,500	--	--	--	--
MOBILE HOMES	1,950	n.a.	n.a.	15	7.7
BUILDING MATERIALS					
Fabricated Structural Materials	5,700	60	1.1	150	2.6
Cement and Concrete	9,425	66	0.7	21	0.2
Plumbing and Heating	2,420	3	0.1	114	4.7
Light Fixtures	2,400	69	2.9	112	4.7
LUMBER AND WOOD PRODUCTS					
Sawmills	6,500	810	12.5	385	5.9
Soft Plywood	1,740	1	~0	58	3.3
PAPER, PULP, CONVERTED PRODUCTS					
Wood Pulp	2,950	1,043	35.4	982	33.3
Paper and Board	14,000	1,760	12.6	1,020	7.3
Converted Paper	8,750	61	7.0	165	1.9
PRIMARY METALS					
Steel	21,300	5,360	25.2	1,975	9.3
Aluminum	8,430	375	4.4	400	4.7
Ferrous Castings	7,671	83	1.1	272	3.5
Primary Zinc	425	258	60.7	8	1.8
Copper Mills	4,180	50	1.2	175	4.2
Brass Mills	2,550	125	4.9	75	2.9
CHEMICALS & ALLIED PRODUCTS					
Industrial Organic Chemicals	12,200	620	5.1	1,570	12.9
Cyclic Crudes & Intermediates	4,020	230	5.7	670	16.7
Chlor-alkali Industry	1,126	36	3.2	246	21.8
Inorganic Pigments Industry	1,050	30	2.9	29	2.8
Industrial Gases	990	--	--	--	--
Inorganic Chemicals, n.e.c. ind.	3,973	800	20.1	1,005	25.3
Fertilizers - Nitrogenous	2,700	325	12.3	260	9.6
Fertilizers - Phosphatic	2,460	110	4.5	800	32.5
Plastic Materials & Resins	7,175	334	4.7	1,133	15.8
Paints & Allied Products	4,964	19	0.4	140	2.8

*All figures are in millions of 1975 U. S. Dollars except percentages.

Industry	Total Shipments ($ Millions)	Imports ($ Millions)	Imports (% of Total)	Exports ($ Millions)	Exports (% of Total)
DRUGS & PHARMACEUTICALS					
Pharmaceutical Preparations	9,095	--	--	--	--
SOAPS & COSMETICS					
Soaps & Detergents	3,430	5	0.1	97	2.8
Toilet Preparations	5,200	28	0.5	109	2.1
RUBBER & PLASTIC PRODUCTS					
Tires and Inner Tubes	5,825	615	10.6	330	5.7
Hose and Belting	1,275	52	4.1	80	6.2
Synthetic Rubber	1,775	66	--	250	--
MOTOR VEHICLES					
Automobiles	27,000	69	--	2	--
Truck-Trailers Industry	576	--	--	55	--
Truck and Bus Body Shipment	1,452	--	--	--	--
Truck and Bus Chassis	9,645	--	--	--	--
AEROSPACE					
Aircraft	13,463	186	1.4	4,734	35.2
Aircraft Engines & Space Propulsion	5,269	258	4.9	1,025	19.5
Aircraft Equipment	5,054	345	6.8	1,898	37.6
Guided Missiles, Space Vehicles, Equipment	4,737	--	--	270	5.7
CONTAINERS & PACKAGING					
Folding Paper Boxes	1,780	--	--	12	0.6
Fiber Boxes	5,965	--	--	20	0.3
Glass Containers	2,870	14	0.5	40	1.4
Metal Cans	6,200	--	--	33	0.5
FOOD & BEVERAGES					
Bakery Products	11,985	48	0.4	14	0.1
Food & Kindred Products	175,850	6,082	3.5	5,676	4.9
Meat & Poultry Products	43,407	1,118	2.6	627	1.4
Canned Fruit & Vegetables	5,089	314	6.2	146	2.9

Industry	Total Shipments ($ Millions)	Imports ($ Millions)	Imports (% of Total)	Exports ($ Millions)	Exports (% of Total)
Frozen Fruits, Vegetables & Specialties	4,823	n.a.	--	70	1.5
Alcoholic Beverages	8,671	919	10.6	45	5.2
Bottled & Canned Soft Drinks	7,290	2	--	6	--
TOBACCO	5,110	--	--	--	--
LEATHER & LEATHER PRODUCTS					
Leather Tanning & Finishing	1,095	70	6.4	140	12.8
Shoes & Slippers	2,875	1,125	39.1	25	0.9
Luggage & Personal Leather Goods	1,500	354	23.6	47	3.1
HOUSEHOLD & CONSUMER DURABLES					
Household Furniture	7,664	77	1.0	285	3.7
Household Appliances	7,865	450	5.7	508	6.5
PERSONAL DURABLES					
Costume Jewelry	530	86	16.2	25	4.7
Precious Metal Jewelry	1,390	74	5.3	70	5.0
Toys, Games, Dolls, Child Vehicles	2,195	283	12.9	79	3.6
Sporting & Athletic Goods	1,849	284	15.4	17	9.4
PHOTOGRAPHIC EQUIPMENT & SUPPLIES	7,315	590	8.1	1,210	16.5
ELECTRONIC EQUIPMENT & COMPONENTS					
Consumer Electronics	2,900	1,870	64.5	346	11.9
Electronic Systems & Equipment	9,400	410	4.4	1,000	10.6
Electronic Components	10,115	1,030	10.2	1,920	19.0
COMPUTING & CALCULATING EQUIPMENT					
Calculating & Accounting Machines	1,390	321	23.1	287	20.6
Computers & Related Equipment	10,000	2,300	23.0	287	2.9
PRINTING & PUBLISHING					
Newspaper Publishing	9,258	--	--	--	--
Periodical Publishing	3,761	--	--	--	--
Book Publishing	3,710	167	4.5	257	6.9
Book Printing	1,300	--	--	--	--
Commercial Printing	11,100	--	--	--	--
Manifold Business Forms	2,229	--	--	--	--

Industry	Total Shipments ($ Millions)	Imports ($ Millions)	Imports (% of Total)	Exports ($ Millions)	Exports (% of Total)
TELEPHONE & TELEGRAPH					
Telephone & Telegraph Equipment	4,489	100	2.3	200	4.6
Telephone & Telegraph Service	35,400	--	--	--	--
BROADCASTING					
Radio Broadcasting	1,730	--	--	--	--
Television Broadcasting	4,110	--	--	--	--
Cable TV	675	--	--	--	--
SHIPBUILDING AND REPAIR	4,560	--	--	--	--
RAILROAD FREIGHT CAR INDUSTRY	1,888	60	3.2	80	4.2
WHOLESALE TRADE	450,734	--	--	--	--
RETAIL TRADE	580,600	--	--	--	--
GENERAL INDUSTRIAL MACHINERY					
Pumps & Compressors	4,330	--	--	--	--
Materials Handling Equipment	3,320	200	6.0	520	15.7
Refrigeration & Heating Equipment	7,585	94	1.2	988	13.0
SPECIAL INDUSTRY MACHINERY					
Farm Machinery & Equipment	5,930	1,020	17.2	1,270	21.4
Construction Machinery & Equipment Ind.	8,480	230	2.7	4,030	47.5
Mining Machinery	1,540	29	1.9	475	30.8
Oil Field Machinery	2,955	--	--	1,300	44.0
Food Products Machinery	1,565	162	10.4	485	31.0
Textile Machinery	755	325	43.0	335	44.3
Printing Machinery Industry	860	90	10.5	300	34.9
GENERAL COMPONENTS					
Values and Pipe Fittings	4,220	332	7.9	688	16.3
Ball & Roller Bearings	1,765	229	13.0	219	12.4
METALWORKING MACHINERY & EQUIPMENT					
Metal Cutting Tools	980	35	3.6	54	5.5
Tool & Die Products	2,550	69	2.7	99	3.9
Welding Machines & Equipment	1,020	58	5.7	208	20.4

Industry	Total Shipments ($ Millions)	Imports ($ Millions)	Imports (% of Total)	Exports ($ Millions)	Exports (% of Total)
INSTRUMENTS FOR MEASUREMENT, ANALYSIS & CONTRACTING					
Engineering & Scientific Instruments	1,560	55	3.5	355	22.8
Measuring & Controlling Instruments	2,300	90	3.9	800	34.8
Instruments to Measure Electricity	2,035	147	7.2	482	23.7
Automatic Environment Controls	710	--	--	43	6.1
Optical Instruments & Lenses	860	180	20.9	142	16.5
MEDICAL & DENTAL INSTRUMENTS & SUPPLIES					
X-Ray & Electro-Medical Equipment	540	180	33.3	200	37.0
Surgical & Medical Instruments	1,450	54	3.7	280	19.3
Surgical Appliances & Supplies	1,650	39	2.4	127	7.7
Dental Equipment & Supplies	480	22	4.6	108	22.5
POWER EQUIPMENT					
Turbine & Turbine Generator Sets	2,380	130	5.5	700	29.4
Power Boiler Industry	1,070	30	2.8	178	16.6
ELECTRICAL EQUIPMENT					
Transformers	1,813	55	3.0	110	6.1

Source: U. S. Department of Commerce, U. S. Industrial Outlook - 1976.

ANNEX B

PUBLIC LAW 94-168

METRIC CONVERSION ACT OF 1975

Public Law 94-168
94th Congress, H. R. 8674
December 23, 1975

An Act

To declare a national policy of coordinating the increasing use of the metric system in the United States, and to establish a United States Metric Board to coordinate the voluntary conversion to the metric system.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Metric Conversion Act of 1975". Metric Conversion Act of 1975, 15 USC 205a note.

SEC. 2. The Congress finds as follows: 15 USC 205a.

(1) The United States was an original signatory party to the 1875 Treaty of the Meter (20 Stat. 709), which established the General Conference of Weights and Measures, the International Committee of Weights and Measures and the International Bureau of Weights and Measures.

(2) Although the use of metric measurement standards in the United States has been authorized by law since 1866 (Act of July 28, 1866; 14 Stat. 339), this Nation today is the only industrially developed nation which has not established a national policy of committing itself and taking steps to facilitate conversion to the metric system.

SEC. 3. It is therefore declared that the policy of the United States shall be to coordinate and plan the increasing use of the metric system in the United States and to establish a United States Metric Board to coordinate the voluntary conversion to the metric system. 15 USC 205b.

SEC. 4. As used in this Act, the term— Definitions. 15 USC 205c.

(1) "Board" means the United States Metric Board, established under section 5 of this Act;

(2) "engineering standard" means a standard which prescribes (A) a concise set of conditions and requirements that must be satisfied by a material, product, process, procedure, convention, or test method; and (B) the physical, functional, performance and/or conformance characteristics thereof;

(3) "international standard or recommendation" means an engineering standard or recommendation which is (A) formulated and promulgated by an international organization and (B) recommended for adoption by individual nations as a national standard; and

(4) "metric system of measurement" means the International System of Units as established by the General Conference of Weights and Measures in 1960 and as interpreted or modified for the United States by the Secretary of Commerce.

SEC. 5. (a) There is established, in accordance with this section, an independent instrumentality to be known as a United States Metric Board. United States Metric Board. Establishment. 15 USC 205d.

(b) The Board shall consist of 17 individuals, as follows: Membership.

(1) the Chairman, a qualified individual who shall be appointed by the President, by and with the advice and consent of the Senate;

(2) sixteen members who shall be appointed by the President, by and with the advice and consent of the Senate, on the following basis—

(A) one to be selected from lists of qualified individuals recommended by engineers and organizations representative of engineering interests;

(B) one to be selected from lists of qualified individuals recommended by scientists, the scientific and technical community, and organizations representative of scientists and technicians;

(C) one to be selected from a list of qualified individuals recommended by the National Association of Manufacturers or its successor;

(D) one to be selected from lists of qualified individuals recommended by the United States Chamber of Commerce, or its successor, retailers, and other commercial organizations;

(E) two to be selected from lists of qualified individuals recommended by the American Federation of Labor and Congress of Industrial organizations or its successor, who are representative of workers directly affected by metric conversion, and by other organizations representing labor;

(F) one to be selected from a list of qualified individuals recommended by the National Governors Conference, the National Council of State Legislatures, and organizations representative of State and local government;

(G) two to be selected from lists of qualified individuals recommended by organizations representative of small business;

(H) one to be selected from lists of qualified individuals representative of the construction industry;

(I) one to be selected from a list of qualified individuals recommended by the National Conference on Weights and Measures and standards making organizations;

(J) one to be selected from lists of qualified individuals recommended by educators, the educational community, and organizations representative of educational interests; and

(K) four at-large members to represent consumers and other interests deemed suitable by the President and who shall be qualified individuals.

Term of office.

As used in this subsection, each "list" shall include the names of at least three individuals for each applicable vacancy. The terms of office of members of the Board first taking office shall expire as designated by the President at the time of nomination; five at the end of the 2d year; five at the end of the 4th year; and six at the end of the 6th year. The term of office of the Chairman of such Board shall be 6 years. Members, including the Chairman, may be appointed to an additional term of 6 years, in the same manner as the original appointment. Successors to members of such Board shall be appointed in the same manner as the original members and shall have terms of office expiring 6 years from the date of expiration of the terms for which their predecessors were appointed. Any individual appointed to fill a vacancy occurring prior to the expiration of any term of office shall be appointed for the remainder of that term. Beginning 45 days after the date of incorporation of the Board, six members of such Board shall constitute a quorum for the transaction of any function of the Board.

Quorum.

(c) Unless otherwise provided by the Congress, the Board shall have no compulsory powers.

(d) The Board shall cease to exist when the Congress, by law, determines that its mission has been accomplished.

Policy implementation. 15 USC 205e.

SEC. 6. It shall be the function of the Board to devise and carry out a broad program of planning, coordination, and public education, con-

sistent with other national policy and interests, with the aim of implementing the policy set forth in this Act. In carrying out this program, the Board shall—

(1) consult with and take into account the interests, views, and conversion costs of United States commerce and industry, including small business; science; engineering; labor; education; consumers; government agencies at the Federal, State, and local level; nationally recognized standards developing and coordinating organizations; metric conversion planning and coordinating groups; and such other individuals or groups as are considered appropriate by the Board to the carrying out of the purposes of this Act. The Board shall take into account activities underway in the private and public sectors, so as not to duplicate unnecessarily such activities;

(2) provide for appropriate procedures whereby various groups, under the auspices of the Board, may formulate, and recommend or suggest, to the Board specific programs for coordinating conversion in each industry and segment thereof and specific dimensions and configurations in the metric system and in other measurements for general use. Such programs, dimensions, and configurations shall be consistent with (A) the needs, interests, and capabilities of manufacturers (large and small), suppliers, labor, consumers, educators, and other interested groups, and (B) the national interest;

Comments and hearings.

(3) publicize, in an appropriate manner, proposed programs and provide an opportunity for interested groups or individuals to submit comments on such programs. At the request of interested parties, the Board, in its discretion, may hold hearings with regard to such programs. Such comments and hearings may be considered by the Board;

(4) encourage activities of standardization organizations to develop or revise, as rapidly as practicable, engineering standards on a metric measurement basis, and to take advantage of opportunities to promote (A) rationalization or simplification of relationships, (B) improvements of design, (C) reduction of size variations, (D) increases in economy, and (E) where feasible, the efficient use of energy and the conservation of natural resources;

(5) encourage the retention, in new metric language standards, of those United States engineering designs, practices, and conventions that are internationally accepted or that embody superior technology;

Consultation and cooperation.

(6) consult and cooperate with foreign governments, and intergovernmental organizations, in collaboration with the Department of State, and, through appropriate member bodies, with private international organizations, which are or become concerned with the encouragement and coordination of increased use of metric measurement units or engineering standards based on such units, or both. Such consultation shall include efforts, where appropriate, to gain international recognition for metric standards proposed by the United States, and, during the United States conversion, to encourage retention of equivalent customary units, usually by way of dual dimensions, in international standards or recommendations;

Public information and education programs.

(7) assist the public through information and education programs, to become familiar with the meaning and applicability of metric terms and measures in daily life. Such programs shall include—

(A) public information programs conducted by the Board, through the use of newspapers, magazines, radio, television, and other media, and through talks before appropriate citizens' groups, and trade and public organizations;

(B) counseling and consultation by the Secretary of Health, Education, and Welfare; the Secretary of Labor; the Administrator of the Small Business Administration; and the Director of the National Science Foundation, with educational associations, State and local educational agencies, labor education committees, apprentice training committees, and other interested groups, in order to assure (i) that the metric system of measurement is included in the curriculum of the Nation's educational institutions, and (ii) that teachers and other appropriate personnel are properly trained to teach the metric system of measurement;

(C) consultation by the Secretary of Commerce with the National Conference of Weights and Measures in order to assure that State and local weights and measures officials are (i) appropriately involved in metric conversion activities and (ii) assisted in their efforts to bring about timely amendments to weights and measures laws; and

(D) such other public information activities, by any Federal agency in support of this Act, as relate to the mission of such agency;

(8) collect, analyze, and publish information about the extent of usage of metric measurements; evaluate the costs and benefits of metric usage; and make efforts to minimize any adverse effects resulting from increasing metric usage;

Surveys. Recommendations to Congress and President.

(9) conduct research, including appropriate surveys; publish the results of such research; and recommend to the Congress and to the President such action as may be appropriate to deal with any unresolved problems, issues, and questions associated with metric conversion, or usage. such problems. issues. and questions may include, but are not limited to, the impact on workers (such as costs of tools and training) and on different occupations and industries, possible increased costs to consumers, the impact on society and the economy, effects on small business, the impact on the international trade position of the United States, the appropriateness of and methods for using procurement by the Federal Government as a means to effect conversion to the metric system, the proper conversion or transition period in particular sectors of society, and consequences for national defense;

Report to Congress and President.

(10) submit annually to the Congress and to the President a report on its activities. Each such report shall include a status report on the conversion process as well as projections for the conversion process. Such report may include recommendations covering any legislation or executive action needed to implement the the programs of conversion accepted by the Board. The Board may also submit such other reports and recommendations as it deems necessary; and

Report to Congress and President.

(11) submit to the Congress and to the President, not later than 1 year after the date of enactment of the Act making appropriations for carrying out this Act, a report on the need to provide an effective structural mechanism for converting customary units to metric units in statutes, regulations, and other laws at all levels of government, on a coordinated and timely basis, in response to voluntary conversion programs adopted and implemented by various sectors of society under the auspices and with the approval

of the Board. If the Board determines that such a need exists, such report shall include recommendations as to appropriate and effective means for establishing and implementing such a mechanism.

SEC. 7. In carrying out its duties under this Act, the Board may—

Committees, establishment. 15 USC 205f.

(1) establish an Executive Committee, and such other committees as it deems desirable;

(2) establish such committees and advisory panels as it deems necessary to work with the various sectors of the Nation's economy and with Federal and State governmental agencies in the development and implementation of detailed conversion plans for those sectors. The Board may reimburse, to the extent authorized by law, the members of such committees;

Hearings.

(3) conduct hearings at such times and places as it deems appropriate;

Contracts.

(4) enter into contracts, in accordance with the Federal Property and Administrative Services Act of 1949, as amended (40 U.S.C. 471 et seq.), with Federal or State agencies, private firms, institutions, and individuals for the conduct of research or surveys, the preparation of reports, and other activities necessary to the discharge of its duties;

(5) delegate to the Executive Director such authority as it deems advisable; and

(6) perform such other acts as may be necessary to carry out the duties prescribed by this Act.

Gifts and bequests. 15 USC 205g.

SEC. 8. (a) The Board may accept, hold, administer, and utilize gifts, donations, and bequests of property, both real and personal, and personal services, for the purpose of aiding or facilitating the work of the Board. Gifts and bequests of money, and the proceeds from the sale of any other property received as gifts or bequests, shall be deposited in the Treasury in a separate fund and shall be disbursed upon order of the Board.

(b) For purpose of Federal income, estate, and gift taxation, property accepted under subsection (a) of this section shall be considered as a gift or bequest to or for the use of the United States.

(c) Upon the request of the Board, the Secretary of the Treasury may invest and reinvest, in securities of the United States, any moneys contained in the fund authorized in subsection (a) of this section. Income accruing from such securities, and from any other property accepted to the credit of such fund, shall be disbursed upon the order of the Board.

Unexpended funds.

(d) Funds not expended by the Board as of the date when it ceases to exist, in accordance with section 5(d) of this Act, shall revert to the Treasury of the United States as of such date.

Compensation. 15 USC 205h.

SEC. 9. Members of the Board who are not in the regular full-time employ of the United States shall, while attending meetings or conferences of the Board or while otherwise engaged in the business of the Board, be entitled to receive compensation at a rate not to exceed the daily rate currently being paid grade 18 of the General Schedule (under section 5332 of title 5, United States Code), including travel-time. While so serving, on the business of the Board away from their homes or regular places of business, members of the Board may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code, for persons employed intermittently in the Government service. Payments under this section shall not render members of the Board employees or officials of the United States for any purpose. Members of the Board who are in the employ of the United States shall be entitled to travel expenses when traveling on the business of the Board.

5 USC 5332 note. Travel expenses.

Executive Director, appointment. 15 USC 205l.

SEC. 10. (a) The Board shall appoint a qualified individual to serve as the Executive Director of the Board at the pleasure of the Board. The Executive Director, subject to the direction of the Board, shall be responsible to the Board and shall carry out the metric conversion program, pursuant to the provisions of this Act and the policies established by the Board.

5 USC 5101 et seq. 5 USC 5331.

(b) The Executive Director of the Board shall serve full time and be subject to the provisions of chapter 51 and subchapter III of chapter 53 of title 5, United States Code. The annual salary of the Executive Director shall not exceed level III of the Executive Schedule under section 5314 of such title.

(c) The Board may appoint and fix the compensation of such staff personnel as may be necessary to carry out the provisions of this Act in accordance with the provisions of chapter 51 and subchapter III of chapter 53 of title 5, United States Code.

Experts and consultants.

(d) The Board may (1) employ experts and consultants or organizations thereof, as authorized by section 3109 of title 5, United States Code; (2) compensate individuals so employed at rates not in excess of the rate currently being paid grade 18 of the General Schedule under section 5332 of such title, including traveltime; and (3) may allow such individuals, while away from their homes or regular places of business, travel expenses (including per diem in lieu of subsistence) as authorized by section 5703 of such title 5 for persons in the Government service employed intermittently: *Provided, however*, That contracts for such temporary employment may be renewed annually.

Financial and administrative services. 15 USC 205j.

SEC. 11. Financial and administrative services, including those related to budgeting, accounting, financial reporting, personnel, and procurement, and such other staff services as may be needed by the Board, may be obtained by the Board from the Secretary of Commerce or other appropriate sources in the Federal Government. Payment for such services shall be made by the Board, in advance or by reimbursement, from funds of the Board in such amounts as may be agreed upon by the Chairman of the Board and by the source of the services being rendered.

Appropriation authorization. 15 USC 205k.

SEC. 12. There are authorized to be appropriated such sums as may be necessary to carry out the provisions of this Act. Appropriations to carry out the provisions of this Act may remain available for obligation and expenditure for such period or periods as may be specified in the Acts making such appropriations.

Approved December 23, 1975.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 94-369 (Comm. on Science and Technology).
SENATE REPORT No. 94-500 (Comm. on Commerce).
CONGRESSIONAL RECORD, Vol. 121 (1975):
Sept. 5, considered and passed House.
Dec. 8, considered and passed Senate, amended, in lieu of S. 100.
Dec. 11, House concurred in Senate amendment.
WEEKLY COMPILATION OF PRESIDENTIAL DOCUMENTS, Vol. 11, No. 52:
Dec. 23, Presidential statement.

ANNEX C

STATISTICAL DATA ON U. S. COMPANIES WITH METRICATION EXPERIENCE

ANNEX C

Annex C contains statistical data on a number of companies identified in the open literature as being in the process of converting to metric or possessing significant metric capability. Where the company is a major Army or DoD contractor, contract awards for 1976 have been listed.

Major sources of data are:

1) ANMC, Metric Conversion in Engineering and Manufacturing (Washington, D. C.: ANMC), 1974.

2) J. J. Keller & Associates, Metric System Guide.

3) ANMC, Metric Reporter, all issues from 1975 to date.

4) ANMC, Managing Metrication in Business and Industry, 1976.

5) Forecasting International, Ltd., Task B Report to DARCOM, 1978.

6) J. J. Keller & Associates, Inc., Metric Yearbook, 1977 Edition (Neenah, Wisconsin: 1977).

7) "The Fortune 500 Directory of the 500 Largest U. S. Industrial Corporations," Fortune, May 1977.

8) "The Fortune Directory of the Second 500 Largest U. S. Industrial Corporations," Fortune, June 1977.

9) Department of Defense, OASD, 100 Companies: Companies Receiving the Largest Dollar Volume of Military Prime Contract Awards, Fiscal Year 1976, November 22, 1976.

The Metric System Guide, (Volume 4) referenced above contains a section which lists manufacturers and suppliers of metric items. For specific company listings the reader is referred to this copyrighted document.

In addition to the major companies listed in the previous table, a number of small companies are converting or have significant metric capability. These include:

American Sign and Indicator Co.
Bell Laboratories
Benrus
Gate City Steel
Information Handling Services
Interdata, Inc.
Nordson Corporation
Pioneer Industries (N. J.)
Porter Precision Products Co.
Simplicity Pattern Co.
Sterling Manufacturing
Stetter Associates
Stock Drive Parts
Universal Oil Products
Vassaretté
Wurlitzer

Note also, we concentrated on manufacturing firms. Two of the major U. S. retailers: Sears, Roebuck & Co. and Montgomery Wards & Co., have also announced plans to convert by the mid-1980s.

U. S. COMPANIES WITH METRIC EXPERIENCE
(Figures are in Millions of Dollars, except Fortune Rating, for 1976)

Company	1976 Total Sales	1976 Fortune Rating	Army Contracts	DoD Contracts
Addressograph Multi-graph Corp.	573	334		
Allied Chemical Corp.	2,630	82		
Allis Chalmers	1,519	146		
Alcoa	2,924	72		
American Can Co.	3,143	64		
American Motors	2,315	94		
Armco Steel	3,151	63		
Black & Decker	748	276		
Borden	3,381	59	5	
Burlington Industries	2,285	98		
Carrier International Corp.	1,112	199		
Caterpillar	5,042	36	5	
Chicago Bridge & Iron Co.	577	331		
Chrsyler	15,538	10	459	469
Clark Equipment	1,261	180	5	
Combustion Engineering Inc.	1,831	125		
Coca Cola	3,033	69		
Control Data Corp.	1,331	173	27	122
Deere	3,134	66		
Dr. Pepper	138	790 (1975)		
Dupont (E.I.)	8,361	16		62
Eaton	1,808	127		
Electra/Midland Corp.**	1,724	128		
Exxon Research & Engineering Corp.*	48,631	1		245
FMC	2,298	97	173	118
Ford Motor Co.	28,840	3	134	285

*Total Company.

**Subsidiary of N. A. Phillips.

U. S. Companies with Metric Experience (Continued)

Company	1976 Total Sales	1976 Fortune Rating	Army Contracts	DoD Contracts
GE	15,697	9	103	1,347
General Mills, Inc.	2,645	81		
General Motors	47,181	2	138	345
Goodyear Tire & Rubber	5,791	23	12	119
Grumman	1,502	148	19	982
Heinz, H. J.	1,882	119		
Hewlett-Packard	1,112	200	8	44
Honeywell, Inc.	2,495	88	57	386
Ingersoll-Rand	1,922	117		
Inland Steel	2,388	92		
IBM	16,304	8	46	256
International Harvester	5,488	27	22	
Litton Industries	3,365	60	73	978
McDonnel Douglas	3,544	51	232	2,465
Motorola	1,494	149	16	89
Munsingwear	100	960(1975)		
Northrup	1,265	179	24	1,480
Pfizer, Inc.	1,888	118		
Pepsi Co.	2,727	77		
Pitney Bowes	539	347		
Polaroid	950	239		
Proctor & Gamble	6,513	19		54
RCA	5,329	31	61	330
Rockwell International	5,220	34	23	966
Singer	2,126	105	10	191
Sperry Rand	3,203	62	30	506
Seven-Up Co.	214	615(1975)		
3M Co.	3,514	53		
Timken Co.	884	253		

U. S. Companies with Metric Experience (Continued)

Company	1976 Total Sales	1976 Fortune Rating	Army Contracts	DoD Contracts
TRW, Inc.	2,929	71	21	292
Union Carbide	6,346	21		
Upjohn Co.	1,026	220		
U. S. Steel	8,604	14		
Xerox	4,404	40	14	

ANNEX D

ANMC SECTOR CONVERSION PLANS

ANNEX D

ANMC SECTOR CONVERSION PLANS

Annex D contains copies of several of the ANMC Sector Plans revealed at the ANMC Metric Planning Forum in April 1978. Sector plans included in this annex are:

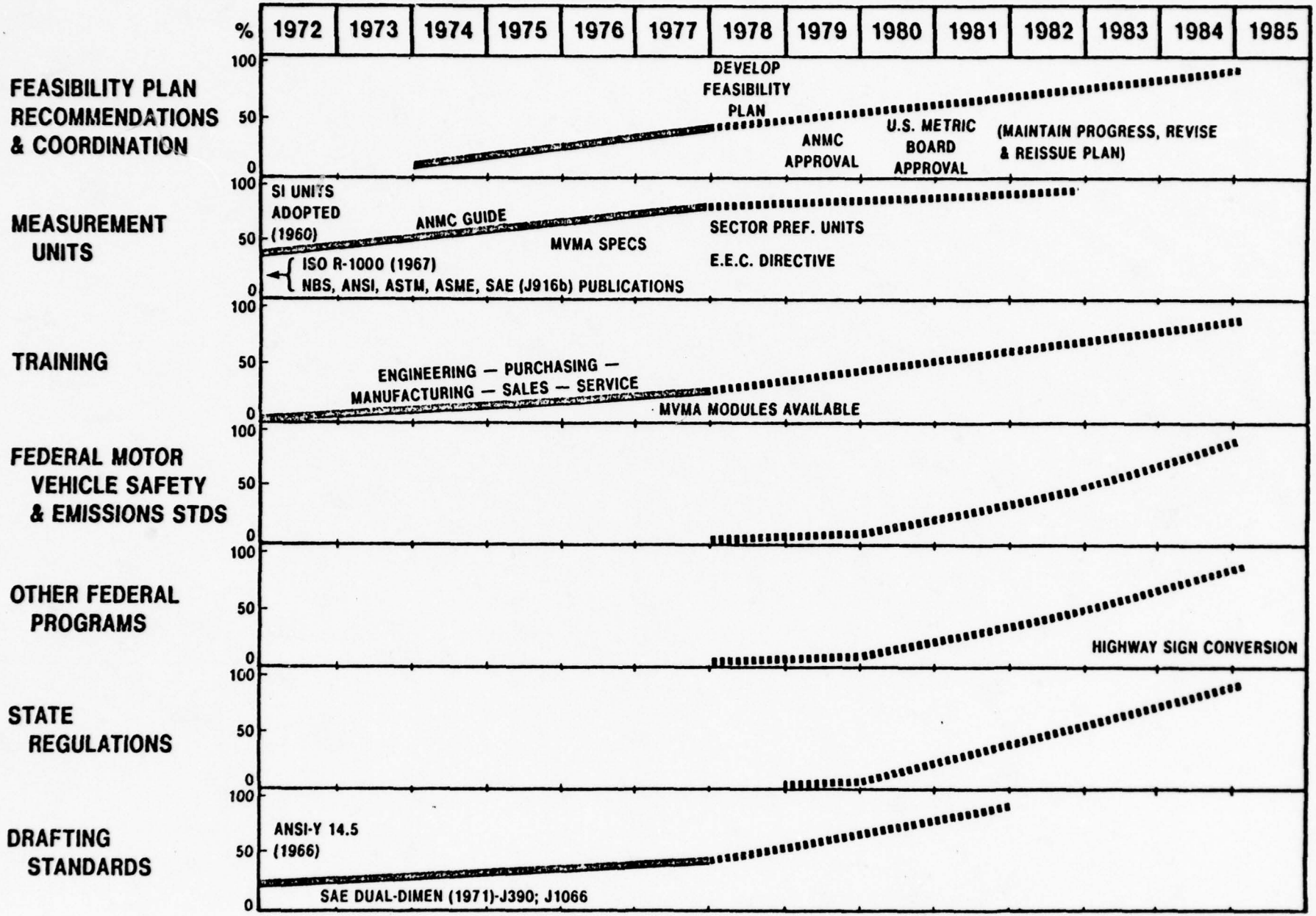
Highway Vehicles Sector (2.04)

Electrical Goods Sector (2.08)

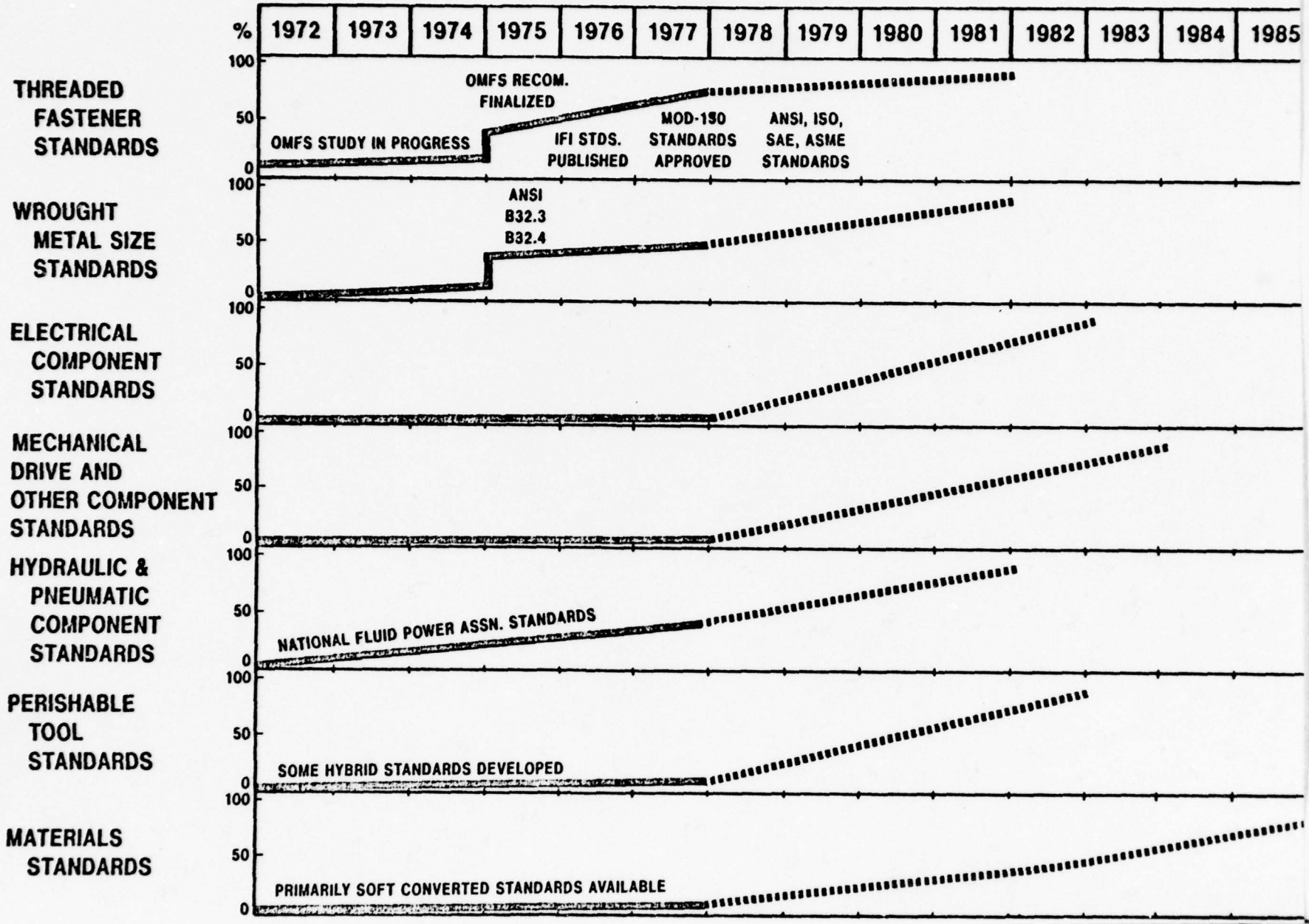
Construction and Agricultural Equipment Sector (2.05)

Instrument Sector

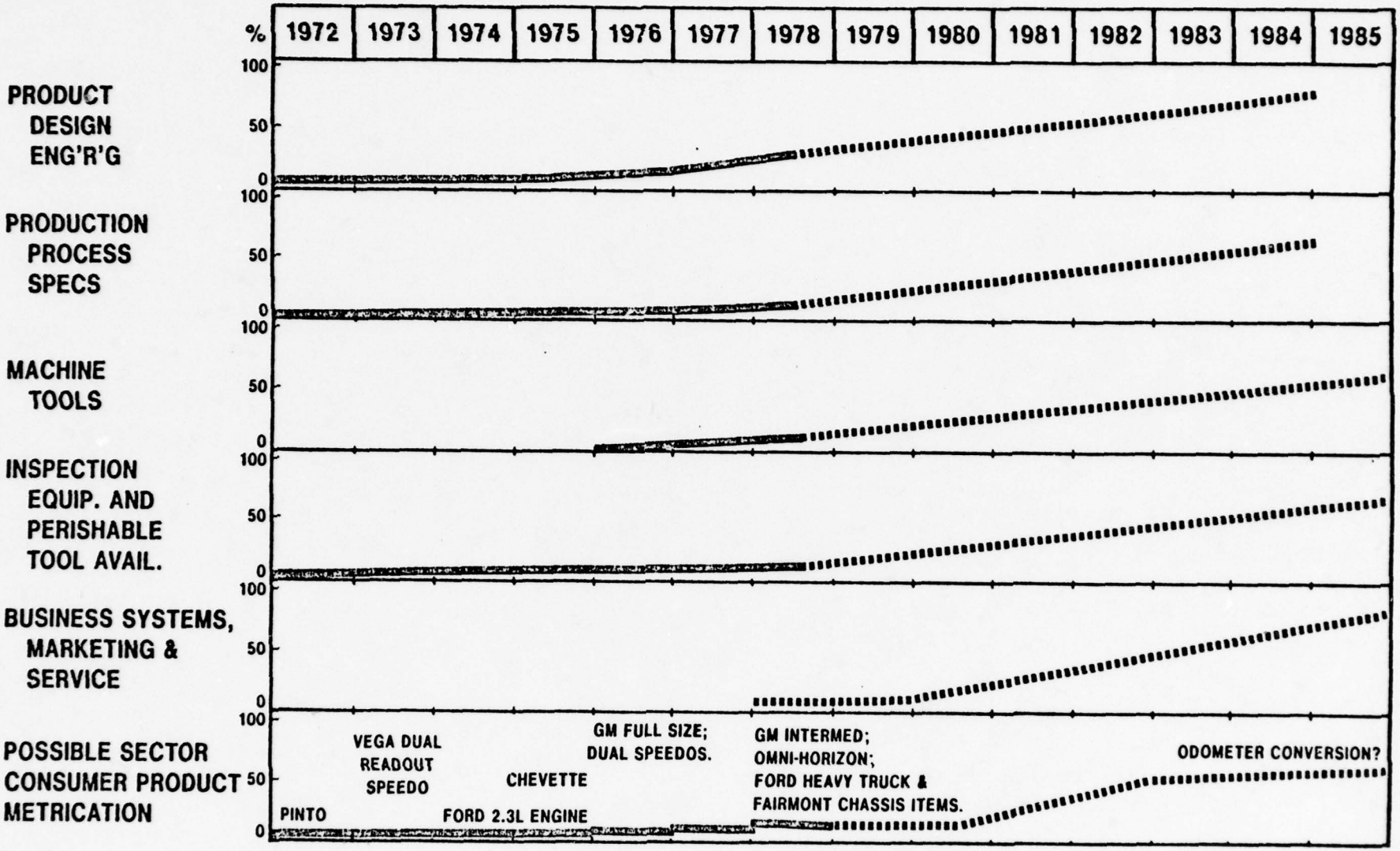
U.S. METRICATION FEASIBILITY PROPOSAL — MOTOR VEHICLES SECTOR (ANMC)



U. S. METRICATION FEASIBILITY PROPOSAL — MOTOR VEHICLES SECTOR (ANMC)

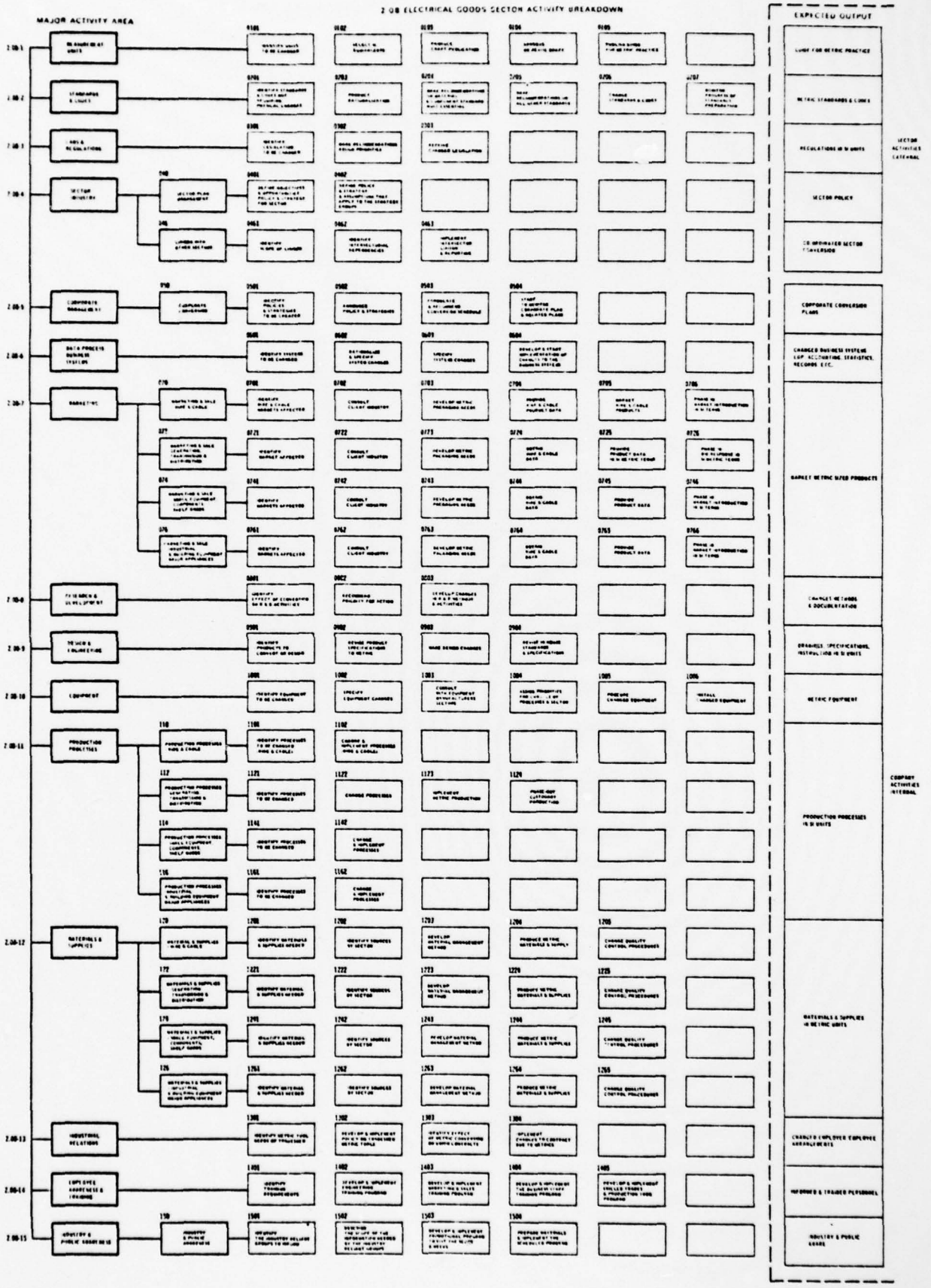


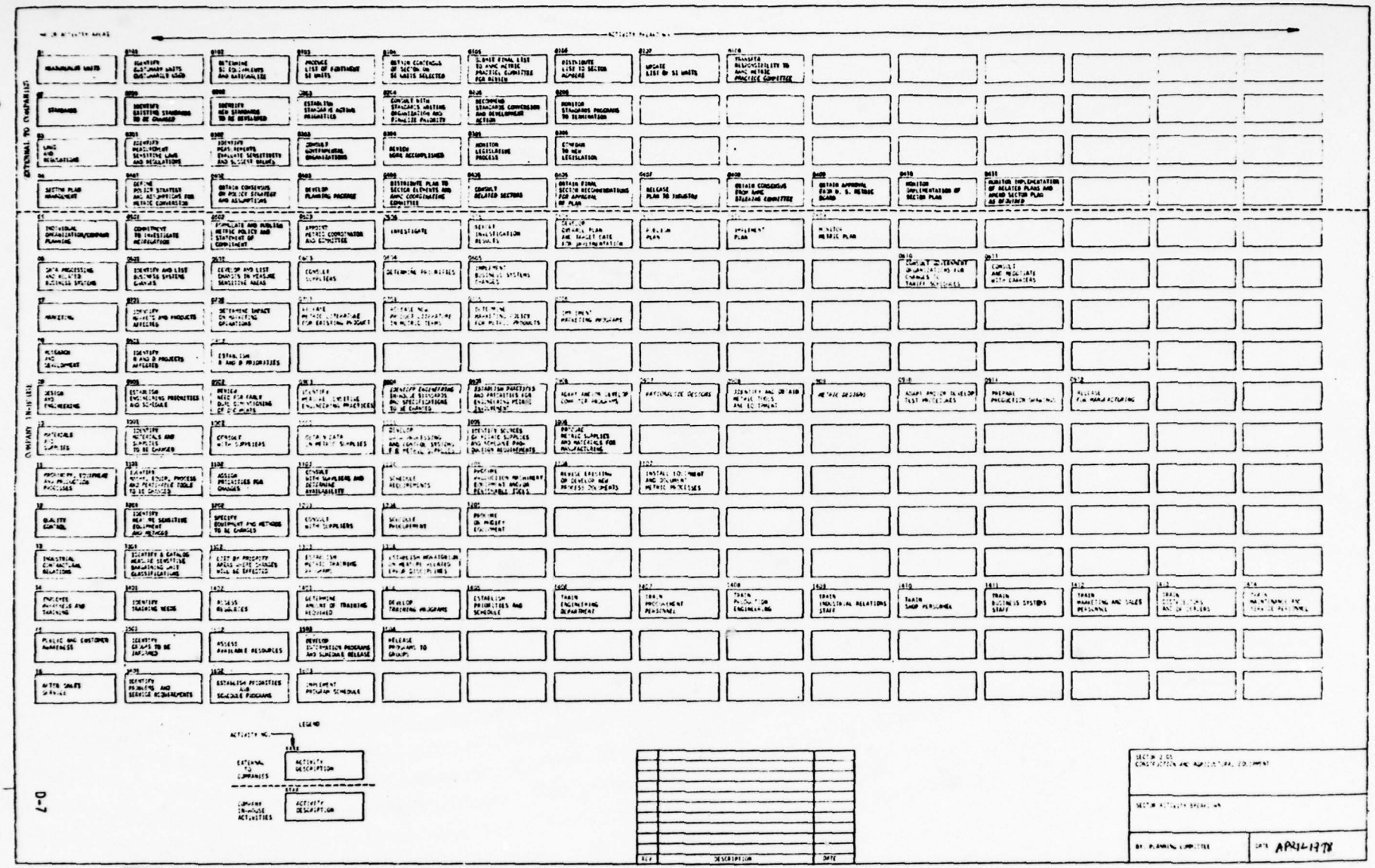
U.S. METRICATION FEASIBILITY PROPOSAL — MOTOR VEHICLES SECTOR (ANMC)



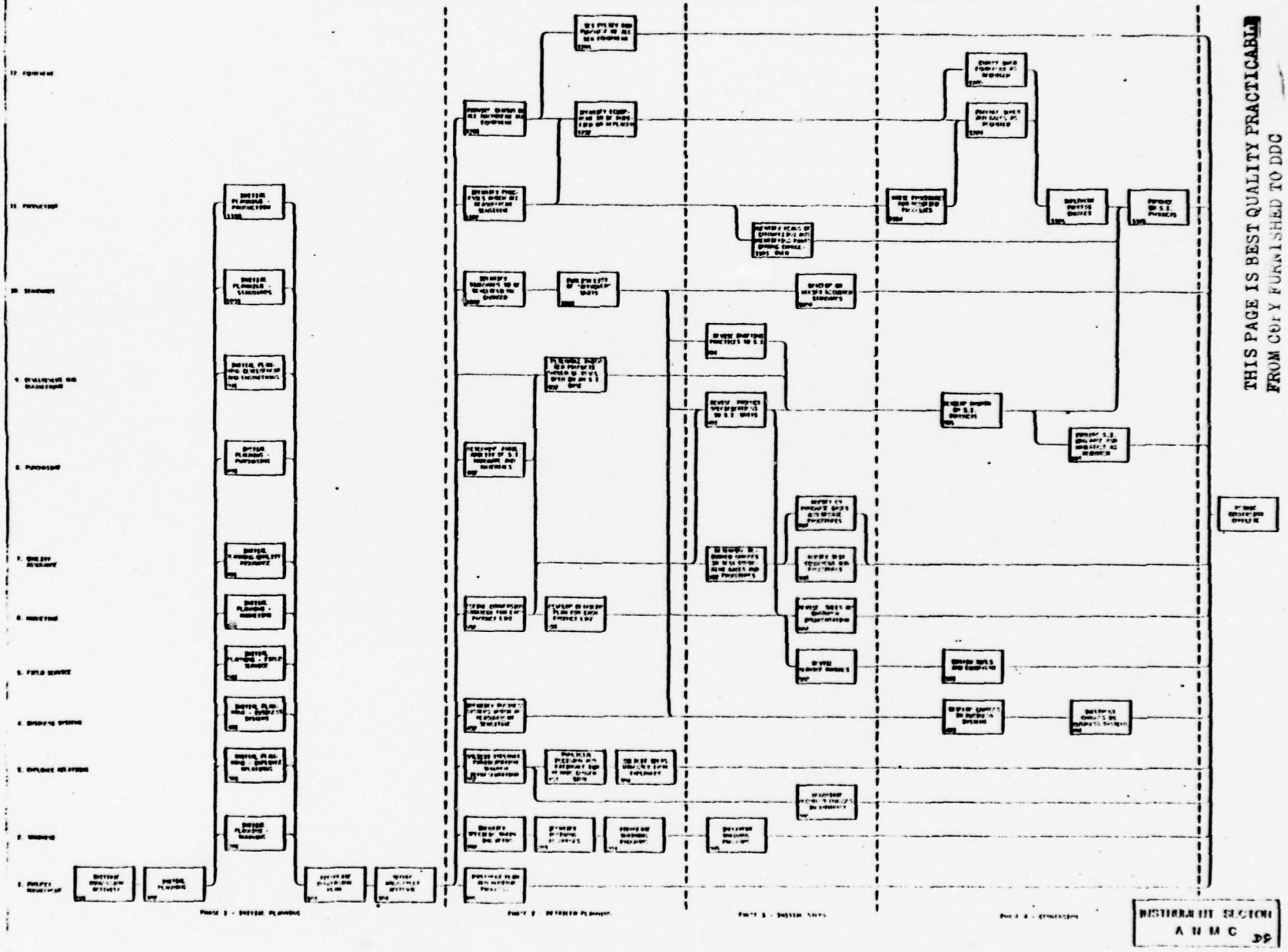
AMERICAN NATIONAL METRIC COUNCIL

2.0B ELECTRICAL GOODS SECTOR ACTIVITY BREAKDOWN





A TYPICAL CONVERSION SEQUENCE FOR A MANUFACTURING COMPANY OR DIVISION IN THE INSTRUMENT SECTOR



ANNEX E

DoD DIRECTIVE 4120.18

USE OF THE METRIC SYSTEM OF MEASUREMENT

December 10, 1976

NUMBER 4120.18

ASD(I&L)

Department of Defense Directive

SUBJECT: Use of the Metric System of Measurement

Refs:
(a) Deputy Secretary of Defense Memorandum, "Use of the Metric System of Measurement," June 10, 1975 (hereby cancelled)
(b) Metric Conversion Act of 1975, 15 U.S.C. 205a-k (PL 94-168)
(c) DoD Instruction 5000.2, "The Decision Coordinating Paper (DCP) and the Defense Systems Acquisition Review Council (DSARC)," January 21, 1975
(d) American Society for Testing and Materials E380 (also numbered ANSI Z210.1 and IEEE Std 268) Standard for Metric Practice, of the issue listed in the DoD Index of Specifications and Standards
(e) DoD Directive 4120.3, "Department of Defense Standardization Program," June 6, 1973

I. PURPOSE

This Directive establishes policies for the use of the metric system of measurement within the Department of Defense.

II. CANCELLATION

Reference (a) is hereby superseded and cancelled.

III. APPLICABILITY

The provisions of this Directive apply to the Office of the Secretary of Defense, the Joint Chiefs of Staff, the Military Departments, and Defense Agencies (hereinafter referred to collectively as "DoD Components").

IV. BACKGROUND AND OBJECTIVES

A. Reference (b) establishes a national policy of coordinating the increasing use of the metric system in the United States. Many Defense-related industries have converted or are planning conversion from

U. S. customary inch-pound measurement system to metric measurements. The Department of Defense must be able to accept such conversion with minimum cost and disruption of operations.

B. Use of the metric system will help foster standardization with our allies and thus promote interchangeability and interoperability, facilitate joint military production programs, and simplify supply operations.

C. Consideration of metric usage is especially appropriate in the design of new Department of Defense Materiel where metric products are expected to be in common use at the time of production release.

D. Generally, it is recognized that industry will take the lead in the changeover and the DoD Components will keep pace by adopting commercially available metric items wherever economically and technically practicable.

V. POLICIES

A. The Department of Defense will consider the use of the metric system in all of its activities consistent with operational, economical, technical, and safety requirements.

B. The metric system will be considered for use in all new designs. When it is deemed not to be in the best interest of the DoD to provide metric design, justification shall be provided. Further, it will be considered in the procurement of all supplies and services. In general, the metric system will be adopted for the following:

1. Where there is a specific military need such as for materiel to be used jointly with NATO and other allied nations.

2. Military materiel which has potential for significant foreign sales or joint production programs.

3. Areas where industry has made significant progress in metric conversion and production facilities are available.

4. Areas where defense-industry preparedness or defense production readiness may be enhanced.

5. Other areas which offer an economic, operational, or other advantage or when no disadvantage is incurred.

C. Physical and operational interfaces between metric items and U. S. customary items will be designed to assure that interchangeability and interoperability will not be adversely affected.

D. Existing designs dimensioned in U. S. customary units will be converted to metric units only if determined to be necessary or advantageous. Unnecessary retrofit of existing systems with new metric components will be avoided where both the new metric and existing units are interchangeable and interoperable. Normally, the system of measurement in which an item is originally designed will be retained for the life of the item.

E. During the metric transition phase hybrid metric and U. S. customary designs will be necessary and acceptable. Materiel components, parts, subassemblies, and semifabricated materials which are of commercial design will be specified in metric units only when economically available and technically adequate or when it is otherwise specifically determined to be in the best interest of the Department of Defense. Bulk materials will be specified and accepted in metric units when it is expedient or economic to do so.

F. Defense Systems Acquisition Review Council (DSARC) reviews and associated Decision Coordinating Papers will address the use of metric units of measurement or reasons for their nonuse (DoD Instruction 5000.2, reference (c)).

G. Technical reports, studies, and position papers (except those pertaining to items dimensioned in U. S. customary units) will include metric units of measurement in addition to or in lieu of U. S. customary units. With respect to existing contracts, this requirement applies only if such documentation can be obtained without an increase in contract costs.

H. Programming and budgeting actions will include resources required to support the DoD effort in converting to the use of metric units. Use of the metric system will be identified and planned so that costs can be included in the budget cycle on an orderly basis.

I. The International System of Units (SI) described in reference (d) will be the metric system used by the DoD.

J. Representatives of the Department of Defense will participate in the development of national and international standards using the metric system, to the extent indicated by DoD interest. NATO and other international metric standards will be used to the maximum practical extent. However, if a U. S. Standard is established with greater definition and restriction than a prevailing international standard, the U. S. Standard will apply.

K. Emphasis will be placed on keeping pace with the conversion or development of specifications, standards, and other general purpose technical data. When the item in question is a military item without a commercial counterpart, the Preparing Activity will assume a leadership role in development of the applicable metric documents as the need arises.

L. When purchasing new equipment, DoD Components are encouraged to specify features which will allow direct measurement in terms of SI units or both SI and U. S. customary units. Use of conversion kits is also encouraged.

M. Training in metric practices and usage will be provided to those personnel whose duties require such knowledge.

N. Use of dual dimensions (i.e., both metric and U. S. customary dimensions) on drawings will be avoided unless it is determined in specific instances that such usage will be beneficial. However, the use of tables on the document to translate dimensions from one system of measurement to the other is acceptable.

VI. RESPONSIBILITIES

A. The Assistant Secretary of Defense (Installations and Logistics), in coordination with the Director of Defense Research and Engineering, and with the advice of the Defense Materiel Specifications and Standards Board (DoD Directive 4120.3, reference (e)), will provide policy and any necessary procedural guidance related to this Directive.

B. The Military Departments and Defense Agencies will appoint a person or establish an office to coordinate metric activities and provide advice on metric conversion within the DoD Component concerned.

VII. EFFECTIVE DATE AND IMPLEMENTATION

This Directive is effective immediately. Two copies of implementing documents shall be forwarded to the Assistant Secretary of Defense (Installations and Logistics) within 90 days.

W. P. Clements, Jr.
Deputy Secretary of Defense

ANNEX F

AR 700-1

ARMY CONVERSION TO THE METRIC SYSTEM OF MEASUREMENT

ARMY REGULATION
No. 700-1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC 7 June 1977

LOGISTICS

Army Conversion to the Metric System of Measurement (International System of Units (SI))

Effective 1 July 1977

This regulation establishes policies and responsibilities for Department of the Army conversion to the Metric System of Measurement (International System of Units (SI)). Local limited supplementation is permitted, but is not required. If supplements are issued, Army staff agencies and major Army commands will furnish one copy of each within 60 days from date of publication to HQDA (DAMA-PPM-M) WASH DC 20310 and DARCOM (DRCQA-PC) 5001 Eisenhower Avenue, Alexandria, Virginia 22333; other commands will furnish one copy of each to the next higher headquarters.

TAGO 274A—June 240-473°—77

CHAPTER 1
GENERAL

1–1. Background. *a.* The Metric Conversion Act of 1975, 15 U.S.C. 205 a–k (PL 94–168), established a national policy of coordinating the increasing use of the metric system of measurement (International System of Units (SI)) in the United States.

b. Department of Defense Directive 4120.18, 10 December 1976, Use of the Metric System of Measurement, established policies for the use of the International System of Units (SI) within the Department of Defense (DOD), and established the following objectives:

(1) Many Defense-related industries have converted or are planning conversion from the US customary inch-pound measurement system to the SI. The Department of Defense must be able to accept such conversion with minimum cost and disruption of operations.

(2) Use of the SI will help foster standardization with our allies and thus promote interchangeability and interoperability, facilitate joint military production programs, and simplify supply operations.

(3) Consideration of metric usage is especially appropriate in the design of new Department of Defense materiel where metric products are expected to be in common use at the time of production release.

(4) Generally, it is recognized that industry will take the lead in the changeover, and that DOD components will keep pace by adopting commercially available metric items wherever economically and technically practicable.

1–2. Purpose. This regulation—

a. Prescribes policies for Army conversion to the SI.

b. Assigns responsibilities for direction, management, and operation of the Army conversion to the SI.

c. Implements Public Law 94–168, 23 December 1975, The Metric Conversion Act of 1975, and Department of Defense Directive 4120.18, 10 December 1976, Use of the Metric System of Measurement.

1–3. Scope. This regulation is applicable to all Army units, organizations, installations, commands, and activities, including the National Guard and US Army Reserve.

1–4. Explanation of terms. In addition to the definitions in AR 310–25, the following explanation of terms will apply to this regulation:

a. Customary System of Measurement. The inch-pound system formerly and currently used in the United States (foot, inch, pound, horsepower, B.T.U., degree Fahrenheit, etc.).

b. Metric System of Measurement. The International System of Units (commonly abbreviated as SI) described in American Society for Testing and Materials (ASTM) E380 Standard for Metric Practice, (also numbered ANSI (American National Standards Institute) Z210.1) and IEEE (Institute of Electrical and Electronics Engineers, Standard 268), of the issue listed in the DOD Index of Specifications and Standards.

c. Metrication. The act of increasing use of the metric system of measurement.

d. Hard Conversion. The process of changing customary measurement units to non-equivalent metric units which necessitates physical configuration changes outside those permitted by established measurement tolerances. Although this term is in general use, it is technically incorrect when applied to specific items because no "conversion" takes place; rather, a new metric item (requiring a new part identification) is designed/created to replace the customary item.

e. Hybrid Metric. Configured in both metric and customary units of measurement.

f. Soft Conversion. The process of changing customary units of measurement to equivalent metric units within acceptable measurement tolerances without changing the physical configuration.

1–5. Responsibilities. *a.* The Deputy Chief of Staff for Research, Development, and Acquisition is responsible for—

(1) Approval and promulgation of overall Army policy on conversion to the SI.

(2) General staff supervision of the implementation of such policies by the major field com-

mands (In coordination with the Deputy Chief of Staff for Logistics and the Comptroller of the Army).

(3) Providing principal and alternate members to the DA Metric Advisory Group (Appendix A).

b. The Deputy Chief of Staff for Logistics is responsible for—

(1) Approval and promulgation of the logistics portion of Army policy on conversion to the SI (In coordination with the Deputy Chief of Staff for Research, Development and Acquisition).

(2) Providing principal and alternate members to the DA Metric Advisory Group.

c. The Comptroller of the Army is responsible for—

(1) Providing policy and guidance to DA Staff agencies and major field commands on programing and budgeting for the resources required to support the Army metric conversion effort.

(2) Providing principal and alternate members to the DA Metric Advisory Group.

d. The Deputy Chief of Staff for Operations and Plans; The Surgeon General; and the Chief of Engineers are responsible for providing principal and alternate members to the DA Metric Advisory Group.

e. The Commanding General, US Army Materiel Development and Readiness Command is responsible for—

(1) Developing and recommending to HQ DA, Army policy on conversion to the SI. This is to be done in coordination with the Chief of Engineers; and the Commanding Generals of the US Army Training and Doctrine Command, US Army Forces Command, US Army Communications Command, and other major field commands.

(2) Establishing and maintaining a central DA Metric Office with responsibilities for—

(*a*) Developing, establishing, and maintaining, an Army plan/program for conversion to the SI.

(*b*) Reviewing and evaluating the effectiveness of Army-wide metric conversion efforts, identifying problems, and initiating and/or recommending corrective actions.

(*c*) Providing for coordination with other military departments, the Defense Logistics Agency, and other Defense Agencies to ensure intraservice/interservice compatibility and maintaining an integrated, cost effective DOD program for conversion to the SI.

(*d*) Providing the Army member to the DOD Metrication Panel of the Defense Materiel Specifications and Standards Board (DMSSB).

(*e*) Providing the Secretariat to the DA Metric Advisory Group.

(*f*) Arranging for DARCOM or other major field commands to provide Army representatives on DOD, Federal Government and/or Industry task forces, boards, or committees on metrication projects or operations to develop policy, standards, specifications, or regulations related to metric conversion.

(*g*) Coordinating metric activities and providing advice on metric conversion within the Army.

(*h*) Providing technical information and assistance in support of Army-wide metric conversion activities.

(3) Evaluating new or revised DOD, national and/or international standards using the SI for Army adoption and recommending appropriate action.

(4) Managing the program for conversion of military specifications and standards, for which the Army is the Assignee and/or Preparing Activity, to the SI (AR 700–47).

(5) Establishing and chairing a Department of the Army Metric Advisory Group. (See Appendix A.)

f. The Commanding General, US Army Training and Doctrine Command (CG TRADOC) is responsible for—

(1) Providing training on the use of the metric system of measurement.

(2) Ensuring that all requirement documents clearly specify operational requirements that may influence the decision on whether new materiel will be designed and configured to the SI.

(3) Converting their materiel and activities to the metric system of measurement in accordance with the policies expressed herein and in general compliance with schedules established by the Army metric conversion plan.

(4) Providing, upon request from the Central DA Metric Office, management indicator data that is required for overall analysis of Army metric conversion efforts.

(5) Ensuring that required metric tools and/or test equipment is available in the field prior to issuing metric materiel to troop units.

(6) Providing principal and alternate members to the DA Metric Advisory Group.

g. Theater Army Commanders; The Commanding General, US Army Materiel Development and Readiness Command; the Chief of Engineers; the Commanding General, US Army Communications Command; US Army Forces Command; Surgeon General; Chief of Army Reserves and National Guard as applicable to the assigned materiel mission are responsible for—

(1) Converting their materiel and activities to the metric system of measurement in accordance with the policies expressed herein and in general compliance with schedules established by the Army metric conversion plan.

(2) Providing, upon request from the Central DA Metric Office, management indicator data that is required for overall analysis of Army metric conversion efforts.

(3) Providing training, as required, on the use of the metric system to their management, scientific, technical trades, and administrative personnel who will not be trained by the TRADOC schools.

(4) Ensuring that required metric tools and/or test equipment is available in the field prior to issuing metric materiel to troop units.

CHAPTER 2
POLICY

2–1. General. Policies set forth herein were established by Department of Defense Directive 4120.18, 10 December 1976, Use of the Metric System of Measurement, for uniform implementation by the Military Departments and DOD Agencies.

a. The Department of the Army will consider the use of the metric system in all of its activities consistent with operational, economical, technical, and safety requirements.

b. The Department of the Army will let industry take the lead in the conversion, however, the Army plan and schedule for conversion will be closely coordinated with industry to ensure that a knowledgeable lead is taken and costs to the Department of Army are minimized.

c. When it is determined that use of the metric system in new designs is not in the best interest of the Department of the Army, based on operational, economic, technical or safety considerations, justification for retaining customary units will be provided.

d. In general, the metric system will be adopted for the following:

(1) Where there is a specific military need, such as for materiel to be used jointly with NATO and other allied nations.

(2) Areas where industry has made significant progress in metric conversion, and production facilities are available.

(3) Areas where defense-industry preparedness or defense production readiness may be enhanced.

(4) Other areas which offer an economic, operational, or other advantage, or when no disadvantage is incurred.

e. In preparing for Army and/or Defense Systems Acquisition Review Council (ASARC and/or DSARC) reviews, Army proponents will ensure that the ASARC/DSARC and associated Decision Coordinating Papers address the use of metric units of measurement or provide reasons for their nonuse.

2–2. Design. *a.* Consideration of the use of the metric system is mandatory for all new designs.

b. During the metric transition phase, hybrid metric and US customary designs will be necessary and acceptable. Materiel components, parts, subassemblies, and semifabricated materials which are of commercial design will be specified in metric units only when economically available and technically adequate or when it is otherwise specifically determined to be in the best interest of the Department of Army. Bulk materials will be specified and accepted in metric units when it is expedient or economic to do so.

c. Where metric and customary US items will be used together, physical and operational interfaces between the items will be designed to ensure that interchangeability and interoperability will not be adversely affected.

2–3. Acquisition. When purchasing new equipment, Army activities are encouraged to specify features which will allow direct measurement in terms of SI units or both SI and US customary units. Use of conversion kits is also encouraged.

2–4. Existing designs. Existing designs dimensioned in US customary units will be converted to metric units only if determined to be necessary or advantageous. Unnecessary retrofit of existing systems with new metric components will be avoided where both the new metric and existing units are interchangeable and interoperable. Normally, the system of measurement in which an item is originally designed will be retained for the life of the item.

2–5. Technical documents. Technical reports, studies, and position papers (except those pertaining to items dimensioned in US customary units) will include metric units of measurement in addition to (in parenthesis) or in lieu of US customary units. With respect to existing contracts, this requirement applies only if such documentation can be obtained without an increase in contract costs.

2–6. Programing and budgeting. Programing and budgeting actions will include resources required to support the Army effort in converting to the use of metric units. Use of the metric system will be identified and planned so that costs can be included in the budget cycle on an orderly basis.

2–7. Specifications and standards. *a.* Representatives of the Department of Army will partici-

pate in the development of DOD, national, and international standards using the metric system, to the extent indicated by Army interest. Use of the International System of Units (SI), in lieu of other metric systems currently in use, will be advocated by Army representatives when establishing agreements and international standards for military and commercial equipment. NATO and other international metric standards will be used to the maximum practical extent. However, if a US Standard is established with greater definition and restriction than a prevailing international standard, the US Standard will apply.

b. Emphasis will be placed on keeping pace with the conversion or development of specifications, standards, and other general purpose technical data. When the item in question is a military item without a commercial counterpart, the preparing activity will assume a leadership role in development of the applicable metric document as the need arises.

2-8. Training. Training in metric practices and usage will be provided, as required, to those personnel whose duties require such knowledge.

2-9. Dual dimensioning. Use of dual dimensions (i.e., both metric and US customary dimensions) on drawings will be avoided unless it is determined in specific instances that such usage will be beneficial. However, the use of tables on the document to translate dimensions from one system of measurement to the other is acceptable.

APPENDIX

THE DA METRIC ADVISORY GROUP

A–1. *Purposes of the Metric Advisory Group.*

a. Periodically review and assess Army policies, procedures, and plans for conversion to the SI.

b. Define specific goals and establish direction in order to promote and attain the Department of the Army's overall metric conversion objectives.

A–2. *Membership.*

a. Membership in the DA Metric Advisory Group will consist of a principal and an alternate from each of the following DA Staff elements and major field commands:

(1) Deputy Chief of Staff for Research, Development, and Acquisition.
(2) Deputy Chief of Staff for Logistics.
(3) Deputy Chief of Staff for Operations and Plans.
(4) The Comptroller of the Army.
(5) The Surgeon General.
(6) Chief of Engineers.
(7) US Army Materiel Development and Readiness Command (Chairperson).
(8) US Army Training and Doctrine Command.
(9) The DA Central Metric Office (Secretariat).

b. When selecting members of the Advisory Group—

(1) A reasonable degree of permanency will be considered in view of the long-term effects of metric conversion.

(2) The names, locations, and telephone numbers of principal and alternate members will be furnished to the Chairperson of the group and any changes will be reported promptly.

A–3. *Other Participation.* Attendance or participation in the activities of the Advisory Group by Army commands, agencies, and activities; other military services; DoD and nonmilitary Government agencies; educational institutions; industry; and private consultants will be as required. Attendance and participation will require prior approval of the Chairperson, Metric Advisory Group.

A–4. *Meetings.* The Metric Advisory Group will be convened at the discretion of the Chairperson.

The proponent agency of this regulation is the US Army Materiel Development and Readiness Command. Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to Commander, US Army Materiel Development and Readiness Command, ATTN: DRCQA–PC, 5001 Eisenhower Avenue, Alexandria, VA 22333.

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:

PAUL T. SMITH
Major General, United States Army
The Adjutant General

DISTRIBUTION:

Active Army, ARNG, USAR: To be distributed in accordance with DA Form 12–9A requirements for AR, Logistics and Logistics Plans—A.

TAGO 274A

ANNEX G

RSI AND INTERNATIONAL ACTIVITIES

ANNEX G

Rationalization, Standardization and Interoperability (RSI) is an important opportunity and focus for Army metrication activities. The impact of RSI in many areas is summarized in Chapter IV "International Activities" in the FY 1979 DoD Program for Research, Development and Acquisition. Excerpts from this document are included below.

1. *President Carter's Initiative at the NATO Summit*

At the May 1977 Summit Meeting in London, President Carter stated that the United States will continue to make the Alliance the heart of our foreign policy and will join with its Allies in strengthening the Alliance politically, economically, and militarily. He further cautioned that the Alliance needs to use limited resources wisely, particularly in strengthening conventional forces. To this end, he called for NATO countries to combine, coordinate and concert national programs more effectively, find better ways to bring new technology into the armed forces, and give higher priority to increasing force readiness.

President Carter also emphasized the need for improved cooperation by NATO countries in development, production, and procurement of Alliance defense equipment, calling for a major effort to eliminate waste and duplication in national programs, to develop, produce and sell competitive defense equipment, and to maintain technological excellence in all

Allied combat forces. In this regard, he stated (1) that the United States must be willing to promote genuine two-way transatlantic trade in defense equipment, (2) that he had instructed the Secretary of Defense to seek increased opportunities to buy European defense equipment where this would mean more efficient use of Allied resources, and (3) that he, President Carter, would work with Congress to this end.

Typical of these, a special rationalization task force is developing plans and procedures for harmonizing Allied R&D armaments production, as is essential for achieving standardization or at least interoperability.

2. Special Budget Elements Relating to NATO

Interwoven with all the other aspects of NATO defense improvement, and indispensable to their success at politically feasible cost, is greater inter-Allied willingness to cooperate in the field of R&D and armaments production. President Carter stressed this aspect heavily in his third defense initiative put forth at the NATO Summit, and promised full U. S. collaboration.

a. NATO Initiatives

The Congress has clearly expressed their direction and interest through Public Law 94-361 of CY 1976. This law stresses that the policy of the United States is to ..."the maximum extent, initiate and carry out procurement procedures that provide for the acquisition of equipment which is standardized or interoperable with equipment of other members of NATO...." This administration is determined to follow that direction.

b. Foreign Weapons Evaluation

DoD Directives require that foreign systems must be evaluated and considered as possible alternatives prior to initiation of new U. S. developments. To support this evaluation requirement, we have established Program Elements with each Service. These programs provide for evaluating foreign developed weapon equipment having potential for application toward U. S. requirements thereby improving standardization and interoperability of weapon equipment with NATO and minimizing duplicative development expenditures.

3. *New Initiatives in Cooperative Armaments Planning and Management*

a. *Standardization Packages (Families of Weapons)*

While the NATO countries have a much stronger industrial base than the Warsaw Pact countries, we must learn how to use it efficiently in cooperative efforts. Any plan which we evolve for cooperation in armament production must recognize that NATO is a confederation of sovereign nations each of which has unique national needs and interests. Therefore, the problem for national armament directors of NATO nations is to determine how to cooperate in armament programs to improve the military effectiveness of NATO in a way that is compatible with each nation's legitimate economic interests.

By this concept of mutually agreed families of weapon we can achieve the military benefits of standardization, as well as the economic benefits of shared production and reduced unit cost.

b. *Periodic Armaments Planning System (PAPS)*

A Periodic Armaments Planning System should provide measures not only to coordinate national programs, but also to establish the standardization/interoperability criteria which nations can adopt in their development programs, e.g., common specifications and standards.

c. *NATO Standardization Agreements (STANAGS)*

NATO studies have concluded that some of the problems in weapons standardization and associated interoperability among forces are due to deficiencies in STANAGS in the basic areas of assemblies, components, spare parts, and materials (ACSM). Subsequent U. S. studies have indicated that both the quantity and quality of STANAGS are lacking, that more STANAGS are needed and many existing documents are outdated and unusable. NATO now has only 600 STANAGS of which 300 (approximately) pertain to materiel.

In order to improve this condition, during 1975, the U. S. proposed a major new initiative which resulted in the formation of a cadre group of national materiel standardization directors to oversee, among other things, all activity in producing STANAGS in the ACSM area. The group (AC/301) held its second meeting in

November 1977 and is expected to foster the preparation of STANAGS to meet the needs of NATO in the long term as well as the near future.

SPECIFIC PROGRESS TOWARD STANDARDIZATION AND INTEROPERABILITY

The primary goal of cooperatin in armaments is increased military effectiveness within probable NATO budget constraints. The more that equipment, munitions, and their logistic support are interoperable, if not fully standardized, the more effectively Allied forces can operate together against the common foe. Standardized or interoperable C^3 (command, control, communications) and interchangeable munitions in particular have a very high payoff in force effectiveness.[6]

ANNEX H

TRAINING PROGRAMS

ANNEX H, APPENDIX 1

CHRYSLER CORPORATION METRIC TRAINING PROGRAM

OUR TRAINING IS DESIGNED TO HAVE PEOPLE THINK AND FEEL METRIC. UPON COMPLETING TRAINING, THE WORKER WILL BE ABLE TO WORK, DESIGN, AND CALCULATE AS EFFICIENTLY AND CONFIDENTLY IN METRIC UNITS AS IN CONVENTIONAL UNITS. WITH PRACTICAL WORKSHOP EXERCISES HE WILL BE ABLE TO CONCEPTUALIZE THE SIZE OF 4 MM AND HAVE THE CONCEPT OF 2.5 KG RATHER THAN ALWAYS HAVING TO CONVERT TO SEE IF HIS ANSWER OR DESIGN IS IN THE CORRECT INCH RELATION BALLPARK.

ELEMENTS OF TRAINING PROGRAM

LET US NOW COVER THE NUTS AND BOLTS OF OUR TRAINING PROGRAM. LOOKING AT THE CORPORATION AS A WHOLE, WE REALIZED WE COULD DIVIDE OUR PEOPLE INTO THREE BASIC GROUPS, NON-TECHNICAL, TECHNICAL AND SPECIALIZED SKILLS. WITH THIS CONCEPT IN MIND, WE DESIGNED THREE METRIC TRAINING PROGRAMS.

PROGRAM I - INTRODUCTION AND GENERAL ORIENTATION TO THE METRIC SYSTEM (TIME: 1 1/2 HOURS)

CANDIDATES: GENERAL OFFICE, CLERICAL AND NON-TECHNICAL PEOPLE. THOSE INDIVIDUALS NEEDING AN AWARENESS AND FAMILIARIZATION OF BASIC METRIC FUNDAMENTALS.

CONTENT: TO INSTILL AN AWARENESS AND BASIC UNDERSTANDING, WE START THE PROGRAM WITH BRIEF METRIC HISTORY.

CHRYSLERS POLICY, AND INVOLVEMENT, AND GENERAL METRIC INFORMATION. AFTERWARDS A SHORT FILM SHOWING HOW THE ENGLISH SYSTEM EVOLVED AND THE SIMPLICITY OF THE METRIC SYSTEM.

TO AID THE INSTRUCTOR IN THE METRIC DEMONSTRATION, ALONG WITH THE STANDARD ARRAY OF SCALES, HEIGHT MEASURING DEVICES, WALL CHARTS AND POSTERS, WE BUILT A FULL SIZE CUBIC METRE THAT HAS DECIMETRE, CENTIMETRE AND MILLIMETRE GRADUATIONS. WITH THE METRE CUBE, WE CAN SHOW THE RELATIONSHIP BETWEEN UNITS OF LENGTH AND AREA. WE CAN THEN PLUCK FROM OUR METRE CUBE, A CUBIC DECIMETRE AND SHOW THE RELATIONSHIP TO VOLUME AND MASS. WITHIN A FEW MINUTES THE LEARNER CAN CONCEPTUALIZE WHAT THE METRIC SYSTEM IS ALL ABOUT. RATHER THAN BE TALKED "AT" ON SINGLE ELEMENTS AND THEN SEEING THE WHOLE, THE EMPLOYEE CAN VISUALIZE THE WHOLE AND THEN WORK TOWARDS THE ELEMENTS. I AM SURE THIS METHOD IS NOT NEW TO MANY OF YOU. AN EXAMPLE OF THIS CONCEPT CAN BE COMPARED TO AN INDIVIDUAL WHO HAS NEVER SEEN AN AUTOMOBILE. IF WE SHOWED HIM AN ENGINE, THEN A SEAT, THEN PERHAPS A MUFFLER, IT WOULD BE VERY DIFFICULT FOR THAT INDIVIDUAL TO VISUALIZE WHAT WE WERE TALKING ABOUT. IT WOULD BE MUCH MORE UNDERSTANDABLE FOR HIM TO SEE THE AUTOMOBILE AND THEN DISSECT IT TO SEE THE ELEMENTS. THIS APPROACH SEEMS TO GET THE MESSAGE ACROSS AND GIVE AN UNDERSTANDING, RATHER THAN SURFACE, MEMORIZED KNOWLEDGE.

THIS EXERCISE IS FOLLOWED UP BY PRACTICAL WORKSHOP. THE EMPLOYEE RECEIVES A 150 mm SCALE AND MEASURES HIS HAND. THE THICKNESS OF A DIME, ESTIMATES HEIGHT OF A DOORWAY, AND ACTUALLY WEIGHS HIMSELF IN KILOGRAMS. WHEN OUR EMPLOYEE LEAVES, HE HAS A SIMPLE UNDERSTANDING OF METRICS.

PROGRAM II - PROFESSIONAL AND SKILLED METRIC TECHNOLOGY
(TIME: 3 HOURS)
PREREQUISITE: PROGRAM I OR BASIC UNDERSTANDING OF METRIC SYSTEM.

CANDIDATES: DESIGNERS, DRAFTSMEN, TOOL MAKERS, PURCHASING AND TECHNICAL ORIENTATED PEOPLE. ALL INDIVIDUALS WHO HAVE THE NEED TO INTERPRET METRIC ENGINEERING DRAWINGS AND USE METRIC CONVERSIONS AND CALCULATIONS IN EVERYDAY WORK TASKS.

CONTENT: CANDIDATES FOR THIS PROGRAM WILL ALREADY HAVE A BASIC METRIC UNDERSTANDING. THEIR KNOWLEDGE WILL HAVE COME FROM EITHER PROGRAM I, PREVIOUS WORK EXPERIENCE OR PAST SCHOOLING. THEREFORE, WE IMMEDIATELY BEGIN A COMPREHENSIVE IN-DEPTH STUDY OF METRIC TERMINOLOGY, CONVERSIONS, CALCULATIONS, PROPER ROUNDING PROCEDURES, AND THE EVER SO IMPORTANT SHORT CUTS. EMPHASIS OF IMPORTANCE WILL BE PLACED IN DESCENDING ORDER STARTING WITH LINEAR MEASUREMENT, AREA, VOLUME, WEIGHT, AND TEMPERATURE.

TO SUPPLEMENT OUR INSTRUCTOR IN THE PRESENTATION OF MATERIAL, WE HAVE SELECTED TO USE UNITED SYSTEMS "TRANSITION TO METRIC" TRAINING MODULES. THESE MODULES WERE DEVELOPED UNDER THE DIRECTION AND SUPERVISION OF THE MOTOR VEHICLE MANUFACTURERS ASSOCIATION (MVMA.) MEMBERS OF MVMA INCLUDE CHRYSLER CORPORATION. AMERICAN MOTORS, CHECKER MOTORS, INTERNATIONAL HARVESTER, WARNER AND SWAZEY (DUPLEX DIV.), AND WHITE MOTOR CORPORATION. MVMA REALIZED THE NEED OF A STANDARDIZED METRIC PROGRAM ORIENTATED TOWARD, AND DESIGNED FOR THE AUTOMOTIVE INDUSTRY.

THE "TRANSITION TO METRIC" PROGRAM CONSISTS OF 14 EDUCATIONAL SUBJECT MODULES. EACH MODULE IS AN INDEPENDENT PRESENTATION WITH THIRTY-FIVE TO FIFTY 35 MM COLOR SLIDES AND A 10-12 MINUTE AUDIO CASSETTE NARRATIVE. AGAIN, I AM SURE MANY OF YOU ARE ALREADY FAMILIAR WITH THIS SET.

FOR PROGRAM II, OUR INSTRUCTOR WILL USE THE FIRST 6 OF THESE MODULES WHICH INCLUDE: INTRODUCTION, LINEAR MEASUREMENT, AREA, VOLUME, WEIGHT AND TEMPERATURE. THESE AUDIO CASSETTE PROGRAMS ARE SUPPORTED BY BLACKBOARD INSTRUCTION AND PRACTICAL WORKSHOP EXERCISES.

PROGRAM III - ADVANCED METRIC TECHNOLOGY SUPPLEMENTS
PREREQUISITE: PROGRAM I AND PROGRAM II OR SUFFICIENT WORKING KNOWLEDGE OF THE METRIC SYSTEM.
CANDIDATES: ENGINEERS, DRAFTSMEN, INSPECTORS, THOSE INDIVIDUALS REQUIRING SPECIAL ABILITY IN HIGHLY TECHNICAL OR UNIQUE AREAS.

CONTENT: A STUDY PROVIDING METRIC TERMINOLOGY AND FORMULAS TO PERFORM ADVANCED ENGINEERING AND SKILLED ASSIGNMENTS IN SPECIALIZED AREAS.

THIS PROGRAM ALLOWS THE SELECTION OF ANY ONE, OR COMBINATION OF THE 8 REMAINING MODULES OF THE UNITEN "TRANSITION TO METRIC" SET THAT I SPOKE OF EARLIER. THESE SUPPLEMENTS CONTAIN, PRECISION MEASURING INSTRUMENTS, METRIC DRAFTING, FORCE, POWER AND WORK, STRESS AND STRAIN, ETC.

THE SUPPLEMENT PROGRAM RANGES IN TIME FROM 30 MINUTES TO 1 HOUR, DEPENDING ON THE MODULE SELECTED. EACH MODULE SUPPLEMENT IS REINFORCED WITH BLACKBOARD EXERCISES AND PRACTICAL WORKSHOP EXERCISES.

AFTER EACH ONE OF OUR THREE PROGRAMS, THE EMPLOYEE IS SUPPLIED WITH A METRIC HANDBOOK WHICH CONTAINS PERTINENT METRIC INFORMATION RELATED TO HIS JOB, SUCH AS, CONVERSIONS, CALCULATIONS, AND WRITING TERMINOLOGY. WITH THIS METHOD, THE EMPLOYEE RECEIVES THE CORRECT METRIC INFORMATION ON HIS PARTICULAR METRIC TASK.

ANNEX H, APPENDIX 2

IBM METRIC TRAINING PROGRAM FOR MANUFACTURING ENGINEERS

IBM ENDICOTT, N.Y.

SI metric

BASIC METRICATION FOR MANUFACTURING ENGINEERS

SI metric

PREREQUISITE: None

COURSE LENGTH: 5 Two-Hour Sessions (10 Hours)

COURSE DESCRIPTION: IBM Endicott's metric implementation plan will be discussed in the first session of this course. The manufacturing engineers will be shown how their job responsibilities will be impacted by the metric conversion and the importance of education for a smooth transition during the conversion period.

This basic course will thoroughly explore the International System of Units (SI), style and format, decimal positioning, precision measurement, and conversion of toleranced and non-toleranced dimensions. Class participation will be achieved through problem solving exercises and measurement workshops.

Session I

Introduction
- Course Content and Objectives
- Advanced Metric Courses
- Why Go Metric?
- The International System of Units (SI)

IBM Goes Metric - Video Tape

Metrication At IBM Endicott
- Implementation Plan
- Organizational Structure
- Education
- Capital Equipment
- Hand Tools and Inspection Equipment

Metrication Status In The United States
- History
- U.S. Metric Study
- Metrication To-Date
- Status of Legislation in Congress

Metrication Within The Community

SI Units
- Base
- Supplementary
- Derived

SI Advantages

Session II

Decimal System versus Powers Of 10
- Exponential Notation
- Base 10 Number System
- Powers of 10

Prefixes

The Base Unit Of Length - metre
- Multiples and Submultilpes
- Measurement Workshop

Decimal Positioning
- Procedure
- Exercises in Decimal Positioning

Session III

Derived Units

Area And Volume
- Decimal Positioning

Velocity And Acceleration
- Feeds and Speeds
- Acceleration Due to Gravity

Force
- Weight versus Mass

Pressure

Problem Solving Workshop (Derived Units)

SI Conversion Approximations
- Length
- Mass
- Temperature
- Volume
- Pressure

Problem Solving Workshop (Conversions)

Session IV

Precision Measurement

Steel Rule - 150 mm
- How to Read
- Examples
- Workshop

Outside Micrometer - 0 to 25 mm
- How to Read
- Examples
- Workshop

Micrometer Depth Gage - 0 to 25 mm
- How to Read
- Examples
- Workshop

Other Measurement Instruments
- Dial Indicators
- Dial Calipers
- Verniers
- Digital Micrometer
- Radius Gage
- Thickness Gage
- Screw Pitch Gage

Session V

General Conversion - Any Unit Of Measure
- Conversion Factors
- Conversion Tables

Computation Techniques
- Significant Digits
- Rounding

Dual Dimensioning
- Customary to SI
- SI to Customary

Converting Toleranced Dimensions
- Tolerances
- Accuracy of Conversion
- Rounding Toleranced Values
- Conversion Procedures

Conversion Workshop

SI Style And Format Exceptions

Course Summary

V-00-A

Employee Development
Department 620
SPD Endicott

Tie Line 252
Extension 1552

IBM ENDICOTT, N.Y.

SI metric

ADVANCED METRICATION FOR MANUFACTURING ENGINEERS .

SI metric

PREREQUISITE: BASIC METRICATION FOR MANUFACTURING ENGINEERS

COURSE LENGTH: 6 Two-Hour Sessions (12 Hours)

COURSE DESCRIPTION: The objective of this course is to teach manufacturing engineers how to manufacture a metric product. To accomplish this, they will be exposed to the essentials necessary for metric pre-release and manufacturing activity.

The course will also discuss how to produce a SI metric part by using available "inch" materials and tools. They will be shown how this is made possible by use of overlapping tolerances on the metric drawings.

Manufacturing engineers will be introduced to drawing format, new symbols, preferred numbers, threads, surface texture, limits and fits, and machining capabilities. They will also be shown what metric materials are currently available and supplier sources.

3/74

ADVANCED METRICATION FOR MANUFACTURING ENGINEERS

Session I

Introduction
- Course Content and Objectives

New Development Drawing Format
- New SI Symbol on Drawings
- New Drawing Sizes

Dual Dimension Drawing Format
- Different SI Symbols on Drawings
- Examples of Dimensioning
- Exceptions to Dual Dimensions

Renard Metric Base Sizes
- Background for Forming Table
- Purpose

Common Usage Preferred Sizes
- Background for Forming Table
- Basis for Common Items

General Drawing Symbols
- Examples

Geometric Tolerance Symbols
- Examples
- New Symbols

Dimensioning
- Correct Way of Dimensioning
- Interpretation of Notes

Session II

Threads
- Compared to Customary
- Tolerance Zones

Thread Disignation
- New Symbols
- Special Symbols
- Possible Thread Symbols

Preferred Threads
- Coarse Thread List
- Tolerance Class
- External and Internal

Comparison Chart
- Reference Material for Engineers

Tap Drill And Clearance Holes
- Drill Size for 75% Thread
- Clearance Sizes
- Supplier Information
- Released Screws

Metric Supplies Available
- Taps
- Nuts
- Hex Key Wrenches

Session III

Cutting Tools
- Comparison Chart
- List of Metric Drills
- End Mills and Centers
- Cutters
- Broaches

Overlapping Tolerances
- Sheet Metal
- Carbon Steel

Available Supplies
- Screw Stock
- Bar Stock
- Dowels
- Washers
- Shoulder Screws
- Precision Balls

Session IV

Surface Texture
- Terminology
- Measured in Micrometres

Roughness Grades
- New Numbers
- Comparisons
- Sampling Length

Symbols For Direction Of Lay
- Explain
- Show Symbols
- Interpretaion

Symbols And How To Identify
- Roughness Grade
- Production Method
- Sampling Length
- Direction of Lay
- Machine Allowance

Unspecified Surface Texture
- Formula
- Maximum Finish
- Exceptions
- Special Requirements

Directives For Various Processes
- Illustration
- Examples

Session V

Machine Capabilities
- General Guidelines

Guidelines For Tolerances And Finishes
- Drilled, Pierced, and Tapped
- General Tolerances
- Drilling and Reaming
- Milling
- Lathes
- Grinding
- Boring
- Honing and Lapping
- Broaching

Stock Allowances
- Reaming and Boring

Session VI

Limits And Fits
- Clearance
- Transition
- Interference
- Comparison to Customary

Fit Descriptions
- Combination of Tolerances
- Table for Hole Tolerances
- Table for Shaft Tolerances
- Illustrations

Dimensioning

- Preferred
- Alternate Method
- Method Which Will be Used by Product

Combinations Of Fit Tolerances

- Minimum Condition
- Maximum Condition
- Average Condition
- Examples

Bearings

- Chart
- Description
- Different Symbols

ANNEX H, APPENDIX 3

ICI, LTD., (AUSTRALIA) METRIC TRAINING PROGRAM

ICI, LTD., (AUSTRALIA) METRIC TRAINING PROGRAM

The ICI Metric Education Panel believe that metric education in an industrial environment is best achieved by self-education, following the principle of direct learning to the level required by the job and carried out immediately prior to the introduction of metric work methods by the work group concerned.

This document is industrially orientated, and is intended to supplement the Australian Metric Conversion Board (MCB) publication. Items 8 to 11 in Appendix 3 and the other ICI education literature listed below.

The education literature provided by the ICI Metric Education Panel is graded to provide information appropriate for all job levels.
The full list of ICI Metric Education Literature is as follows:

1.	METRIC NOTATION •	(For stenographers and typists)
2.	THINKING METRIC – PART I – COMMON UNITS•	(For all staff levels requiring reasonable knowledge of common metric units.)
3.	PART 2 – TECHNICAL UNITS•	(For technical and scientific staff)
4.	EXERCISES IN COMMON SI UNITS•	(For staff receiving "Thinking Metric Part 1".)
5.	YOUR GUIDE TO SI UNITS•	(For issue to non-technical staff when "Thinking Metric Part 1" is withdrawn)
6.	EVERYDAY METRIC UNITS	(For staff requiring only a very general knowledge of SI Units.)
7.	EXERCISES IN EVERYDAY METRIC UNITS	(For staff receiving 6.)
8.	METRIC UNITS FOR PROCESS OPERATORS	(For process operators)
9.	MANUAL OF METRIC PRACTICE FOR• ENGINEERS AND DRAUGHTSMEN	(For draughtsmen and some engineers.)
10.	METRIC TRADE NOTES – ELECTRICAL – FITTING & MACHINING – WELDING & BOILERMAKERS – CARPENTRY & JOINERY – PLUMBERS – RIGGERS	
11.	METRIC NOTES FOR DRIVERS & MOTOR MECHANICS	

Bulk quantities of all publications are available from ICI Melbourne at nominal cost.

• Available from the Chamber of Manufactures in all States in any quantities.

It is recommended that draughtsmen and engineers should study "Thinking Metric Part 1" first and complete "Exercises in Common SI Units" before commencing the study of this manual. For those requiring further information reference should be made to "Thinking Metric Part 2" and the literature in Appendixes 2.

It is appreciated that assistance may be required by some employees where the self education principle is applied. ICI is providing this assistance by means of Area Tutors who are readily available for consultation. They are required to contact each individual in their area two weeks after the issue of the literature and during the week prior to 'M' day to resolve any problems they may have encountered. This system is recommended for others using ICI literature with the direct learning principle.

ANNEX I

IMPACT OF METRIC CONVERSION ON U. S. ARMY LOGISTICS FUNCTIONS

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ANNEX I

THE IMPACT OF METRICATION ON ARMY LOGISTICS FUNCTIONS

Introduction

This annex addresses the impact of metric conversion on supply, maintenance, quality assurance, testing and evaluation, and training elements of Army logistics.

The approach taken has been to review the entire spectrum of logistics activities from the point of view of anticipated metric impact, focusing primarily on items approved for production. In conducting the analysis, the FI staff has drawn heavily upon foreign and domestic experience and appropriate Army logistics documents.

In order to verify the conclusions drawn and to supplement the analysis, FI representatives carried out a one day workshop at the U. S. Army Logistics Center, Ft. Lee, Virginia. Representatives of the ILS Management Office, Training and Education Directorate, and Organization Directorate attended. Completed questionnaires were also submitted by representatives of the Armaments and Missiles Division, Troop Support Division, Tank and Automotive Division, Aviation Division, Communications and Electronics Division of the Materiel Directorate. The comments and insights of the panel are included at the end of each chapter of this annex.

CHAPTER 1

IMPACT ON METRIC CONVERSION ON SUPPLY ELEMENTS OF THE U. S. ARMY LOGISTICS FUNCTION

The purpose of this chapter is to highlight the specific impacts of metric conversion on the supply elements of the U. S. Army logistics function. The purpose of the discussion is to identify broad points of metric impact for the decision-maker.

Classes of supply, described in AR 11-8 (April 15, 1976), are as follows:

Class I	*Subsistence including gratuitous health and welfare items.*
Class II	*Clothing, individual equipment, tentage, tool sets and tool kits, hand tools, administrative, and housekeeping supplies and equipment. Includes items of equipment, other than principal items, prescribed in authorization/allowance tables and items of supply (not including repair parts).*
Class III	*POL - Petroleum and Solid Fuels. Includes bulk and packaged fuels, lubricating oils and lubricants, petroleum based specialty products; solid fuels, coal and related products.*
Class IV	*Construction - Construction materials to include installed equipment, and all fortification/barrier materials.*
Class V	*Ammunition - Ammunition of all types (including chemical, radiological and special weapons), bombs. explosives, and mines, fuzes, detonators, pyrotechnics, missiles, rockets, propellants, and other associated items.*

Class VI	*Personal Demand Items (Nonmilitary Sales Items).*
Class VII	*Major End Items: A final combination of end products which is ready for its intended use (principal item); e.g., launchers, tanks, mobile machine shops, vehicles.*
Class VIII	*Medical materiel including medical peculiar repair parts.*
Class IX	*Repair parts and components to include kits, assemblies and subassemblies, reparable and nonreparable, required for maintenance support of all equipment.*
Class X	*Materiel to support nonmilitary programs; e.g., agricultural and economic development, not included in Classes I-IX.*

The magnitude impact of metric conversion will vary with the sophistication, measurement sensitivity, use and other aspects of the item.

Within the context of logistic functions, a mechanism for supply support must be devised. The supply support must encompass "all management actions and execution necessary for determining requirements for acquisition, cataloging, packaging, preservation, receipt, storage, transfer, issue and disposal of both principal and secondary items."* In the following discussion, the points of metric impact for each of these supply support elements are discussed.

Acquisition. In assessing the impact of metric conversion on the acquisition of supplies, we limit the discussion mainly to acquisition of primary and secondary items already certified for production. In this context, a decision has been reached that items within the various supply classes have been accepted for future issue to user units or individuals. The logistics supply function is to assure that sufficient quantities shall be acquired to meet user needs.

*As stated in AR 700-127 (June 1, 1975).

The major impact of U. S. metric conversion depends on decisions made in relation to long life equipment. In the long run, a decision today to build long life equipment using the customary inch-pound system of measurement will have a potential adverse impact on the acquisition aspect of U. S. Army supply support. U. S. industry is rapidly converting to metric and eventually, U. S. industrial inch capabilities will disappear. This poses a problem to U. S. Army supply support functions as continued use of inch dimensioned long life equipment may eventually lead to higher costs of some supplies.

It should be noted that the decision to use the metric instead of the inch-pound system in the development of long life equipment presents no new supply/acquisition problems to the U. S. Army. Supplying unique long life systems is already handled by the current decision mechanism and the metric-inch issue just adds another dimension to the problem of acquiring sufficient quantities of supply items for user needs.

The alternatives which are available to the supply support system in supplying a new piece of equipment are:

1. to stockpile parts;
2. to mothball the production line;
3. to keep the production line open by spreading out the procurement time-table;
4. To special order parts and pay premium price.

In dealing with this problem, the Australian strategy has been to stockpile parts. Their philosophy is to buy now, while production capability exists. U. S. industry strategy is not yet well defined.

Adoption of this strategy would require relatively accurate usage rate data, and early and rather precise establishment of the life cycle end date. Stockpiling will add to front end system procurement costs while delayed or stretched procurement will increase life cycle costs, especially when the effects of inflation are considered. Increased costs of repair parts may then be great enough to cause early phase out of a system.

What is critical for the U. S. Army in the acquisition of supplies, whether they be primary or secondary items, is an awareness of the progress of metric conversion of U. S. industry and coordination of Army activities to keep pace as appropriate. Coordination with industry is especially pertinent in assessing the availability of supplies normally bought "off the shelf".

Cataloging. Cataloging is taken to mean the process of assigning an identification code (e.g., part number) to each supply item so that users may order supplies. U. S. industry experience was not examined in sufficient detail to provide insight into this question.

With gradual conversion to metric dimensioned items, there is clearly an opportunity for confusion, duplication, etc. The major factors that must be dealt with are:

1. development of policies on the assignment of numerical identification codes (discussed below) and;

2. provision of metric awareness and appropriate technical training of affected personnel.

Regarding policy decisions on the assignment of catalog numbers, several options are available. The following represents the Australian Department of Defence (Navy) policy on cataloging of metric materiel:

> *Policy for cataloguing new items, straightforward: a new catalogue number is given. For materiel which is purchased as an alternative to formerly-used imperial items; if there is no variation in dimensions, materiel or quality, then the existing imperial item catalogue number is applied to the metric item; if the variations in these properties is not significant to the function it has to perform, and is less than 5%, then the existing number is applied. In all other cases, a new catalogue number is to be allocated.**

*Department of Defense (Navy), "Aspects Requiring Particular Attention When Converting to SI Metric Units", (See Figure 16-6, p. 104 of Forecasting International, Ltd., DARCOM Metrication Final Report on Task A: Foreign Experience, Volume 1, November 8, 1977.)

Similar U. S. Army and Federal policies and procedures are already established for cataloging new similar and duplicate inch-pound dimensioned items. Metrication will require policy statements, but the mechanism for handling the decisions and implementation of cataloging metric supplies is already in place. Metric awareness programs and training for individuals who need more dpeth of metric understanding to carry out their jobs may be required.

In summary, the policy of concentrating on new equipment for metric conversion will alleviate the problem. New tanks normally have a limited number of parts which are interchangeable with those of old tanks. The introduction of new equipment is what increases the cataloging problem, not the fact that the parts do or do not have metric dimensions. Prominent exceptions are fasteners and like items which will require separate catalog entries for those with metric dimensions.

Packaging. Packaging includes "the processes and procedures used to protect materiel from deterioration and/or damage. It includes cleaning, drying, preserving, packing, marking and unitization."* These activities are dependent on appropriate standards, specifications and drawings. There are standards and specifications for cleaning, preserving, packaging and marking. In addition there are drawings for packing and marking. With conversion to metric, these standards, specifications and drawings will eventually have to be converted. This raises the issue of soft vs. hard conversion which will have to be resolved as appropriate for each case, where metric conversion of an item affects packaging requirements.

The issue of soft and hard conversion is particularly important with respect to standards, specification and drawings for packaging, which ranges from cardboard cartons to freight forwarding containers. Packaging is sensitive ot national, industrial and U. S. Army

*AR 310-25, Dictionary of United States Army Terms, April 12, 1977.

decisions. Two types of conflicts could emerge; one where a metric dimensioned item must be packaged according to customary standards and specifications and a second where a customary dimensioned item must be packaged in a metric dimensioned container.

A second area of concern is the fact that the Army uses Federal Standards, MILSTDs, MILSPECs and industry standards and specifications. This use of standards and specifications from a variety of sources requires coordinated effort to ensure that appropriate, consistent and compatible metric standards and specifications are available when needed.

In addition, metric conversion may have other impacts. Let us examine the packaging element in the context of the U. S. metric environment. For example, assume the U. S. wood industry establishes a set of preferred, rationalized metric sizes and begins producing wood to be used for packaging in these preferred metric sizes. To pursue a policy of minimizing costs the Army will have to buy wood in the preferred metric sizes. This conversion may lead to:

1. redesign of packaging;
2. need for appropriate metric standards and specifications for packaging;
3. new physical sizes of packaging which conflict with storage/transportation space provisions;
4. conflict between package size and the item to be packaged.

Other impacts of metric conversion would include the potential need for new tools and scales, and for trained personnel.

Another aspect of the problem is the potential for the General Services Administration (GSA) or the Defense Supply Agency (DSA) to purchase standard industry items that have been converted to metric. Being unaware of this may impact on the packaging element of supply support. This situation indicates a need for careful monitoring of industry activities as well as coordination with GSA and DSA.

Preserving. Only minimal impacts of metrication are envisoned as related to preserving of items. In the case of a controlled environment, requirements on correct parameters might have to be converted to SI units in the applicable standards or specifications, e.g., temperature requirements. Gauges and related measuring devices might also have to be modified.

Receipt. Receipt is viewed here as the act of receiving supplies. Metrication could have some impact in relation to generating confusion, requiring standardized forms to be changed and generating a need for job-related training. Where automatic data processing is used to record receipt of items, provisions must be made for the acceptance of SI units and item descriptors in the automated system.

Storage. Storage is taken to mean the act of storing supplies. Storage facilities available include warehouses, dumps and parks. Dumps and parks are essentially outdoor facilities and metric conversion is likely to have no impact on storage in these areas, beyond the initial layout phase. To lay out one of these facilities in metric units might require appropriate measuring devices and minimal personnel training. On the whole, however, impacts are deemed trivial.

Storage facilities such as warehouses and depots may be affected by metric conversion. The potential effect of changes in packaging on storage space has been mentioned above. Space may have to be reallocated and where shelving and storage spaces are not adjustable, space may not be used as efficiently as is possible.

Another issue arises in relation to the storage of metric and inch dimensioned parts. Should both be stored in the same warehouse -- or in separate warehouses? Australian experience suggests that storage of both in the same warehouse constitutes the most efficient approach. It is their experience that effective labeling and appropriate training can control (if not eliminate entirely) the problems associated with dual inventories which will be necessary during transition.

The need for dual inventories during the transition may require additional space and must be planned for. Dual inventories are probable for hardware items such as pipes, millstocks, fasteners, etc. It should be recognized that, in the long run, metric conversion will simplify the storage/inventory problem -- as rationalized sizes are adopted and widely used.

Transfer. In examining this element, transfer has been defined as the physical act of moving goods from one point to another. The impact of metric conversion on the U. S. Army in this area will ultimately depend upon the decisions made by the national transportation industry. Major impacts of metric conversion will be in the areas of shipping, especially containerized shipping, pallet sizes and in fluid transport. The U. S. Army utilizes both public transportation facilities and its own network for moving goods. As rational metric package sizes become more common, there may be decisions in the industry to alter standard shipping containers and pallet sizes to suit metric packaging. Regarding fluid transport, the impact will occur over time, in metering pipeline flow and in relation to the eventual shift to rationalized metric pipe sizes. The paperwork associated with transfer may also be affected.

Army transfer practices will be sensitive to national transportation industry metric policies and decisions. Thus, careful monitoring of industry and appropriate adjustment of U. S. Army practices will be required to cope with the potential changes resulting from metric conversion of the national transportation system.

Issue. Issue is taken to mean the process of responding to a requisition from the user for a particular item. It is anticipated that metric conversion will have only minimal impacts on this process. The key impact may be the lack of familiarity with the measurement units which is significant in the case of measurement sensitive items, e.g., gasoline, milk, bags of cement. For example, a cook must be trained in metric units so that he can requisition adequate

amounts of foodstuffs in metric units to feed the troops. The results of metric conversion, in this example, are that the cook has a loss of experience in judging what he needs and what he gets; menus must be changed, etc. The loss of experience and unfamiliarity problems will be solved with appropriate training and time.

In issuing items such as subassemblies, a mechanism must be devised to ensure that appropriate tools are available to the user. While this may not be a unique problem, metric conversion, especially in the early phase, will create the demand for attention to the problem of the availability of common metric tools and training.

Panel Assessment

While precise quantitative evaluation is not possible, it definitely appears that metric conversion will require additional procurement to ensure operability over the equipment life cycle. This will entail dual stockage of some types of items with a corresponding need for greater storage space. The additions in volume and weight will add to transport requirements if stocks are to be mobile. Problems will be particularly acute with Class II and IX supplies. This may also bring about problems with small vendors unable to convert rapidly to meet requirements for supplies in metric dimensions.

In addition, conversion may narrow the supply base, either by requiring metric dimensions in the early stages or customary units in the latter stages. Since the Army's ability to influence industry is limited, the problem may become sufficiently critical to cause early phase out of old equipment in order to meet readiness criteria. Even in the best of circumstances, the problem of supply of repair parts for old customary dimensioned equipment will be a matter of concern.

Difficulties in cataloging lie in the provision of current information, a problem not peculiar to metric conversion. It will be necessary to differentiate common use items by stock number. While the impact can not be determined precisely, this additional requirement may cause an overflow in data storage.

The only impact on packaging relates to changes in standards and considerations pertaining to re-usable containers. No impact on preserving was foreseen.

The panel recognizes that metric conversion will have similar impacts on receipt, storage, transfer, and issue. For example the accounting process involved in each of these areas will affect Automated Data Processing. Additional machine time will be required. Segregation of customary and metric items will be necessary and may create space, handling or location coding problems. In time, van and pallet sizes may have to change to accommodate metric packaging with a possible impact on handling equipment. Increased stockage volume resulting from dual stockage will have an effect on the mobility of direct and general support units.

The panel expressed concern about the ability of the industrial base to meet the Army's dual supply demands. Inability to support the Army's dual supply needs will have profound effects on operational readiness.

CHAPTER 2

IMPACT OF METRIC CONVERSION ON MAINTENANCE ELEMENTS OF THE U. S. ARMY LOGISTICS FUNCTION

The impact of metrication on the maintenance function may be seen by arraying maintenance operations against maintenance levels (as described in AR 750-1). Attention may be focused directly on possible metric impact points by indicating the applicability of each maintenance operation to each maintenance level (e.g., major re-work operations are performed at the depot level). This is done in Figure 1 on the basis of analysis by FI staff. The applicability of each maintenance operation to the maintenance levels is indicated by a digit (0 = not applicable, 1 = applicable, 2 = applicability inferred); similarly, the metric impact at each operation and level is indicated by a 1 at the intersections. The following paragraphs provide the rationale for these judgments and discuss the nature of metrication impacts to be expected at these intersections. As in the preceding chapter, the discussion will be followed by a panel assessment of the problems.

Inspection. Inspection includes a variety of visual, tactile and other tests and checks of the "Pass-Fail" type. Since measurement scales are not directly involved, there would be no metric impact.

Testing and Servicing. Testing and servicing do involve measurement, hence there will be a metric impact at all maintenance levels. Metrication will affect training; test, measurement, and diagnostic equipment (TMDE); documentation (specifications, technical manuals, field manuals, etc.); and (at the depot level) test and servicing facilities. The significance or intensity of the metric impact will depend on the maintenance level and the nature of the item being tested or serviced. Training at the organizational level, for instance, would include little more than metric awareness; more

extensive training (in the use of TMDE, for example) would be necessary for depot level personnel. The metric impact will be minimized if the associated documentation, TMDE, and training are coordinated and consistent. As an example, the day when technical manuals prescribe tire pressures in kPa will pass unnoticed if metric pressure gauges are available and people are aware of metric pressure units.

Calibration. Calibration operations, conducted at the direct and general support, and depot levels, will also feel the impact of metrication in terms of facilities, equipment, documentation, and training requirements. Training requirements will be at a more technical level than would be satisfied by a metric awareness program; the people involved, however, should have few problems because of their technical backgrounds. Then, too, in some areas (e.g., electrical/electronic) the unit changes imposed by SI will be minimal. The impact on equipment will depend on the particular situation. Conversion tables may suffice in some cases; in others modifications to provide SI or dual readout may be necessary; in the worst case duplicate equipment (one in customary units, the other in SI) may be required. In this eventuality, there would be an adverse impact on facility space, power, and environmental systems requirements; mobile calibration facilities would be particularly affected.

Replacement. Metrication will have an impact on operations involving replacement of parts, modules, subassemblies, and assemblies at all maintenance levels. Training, documentation, and tools requirements would be affected, the extent depending on the complexity of the replacement item and the maintenance level doing the work. The magnitude of the tools problem will be affected by general policies with respect to hybridization and the provision of metric tools to the field. If an interoperable metric module were to replace a defective inch module, for instance, the attaching fasteners involved might be either inch or metric; inch fasteners would simplify the replacement if common metric tools had not been distributed.

FIGURE 1

IMPACT OF METRIC CONVERSION ON MAINTENANCE OPERATIONS AT VARIOUS MAINTENANCE LEVELS

Maintenance Operation	Organizational		Direct and General Support		Depot	
	Operation Applicable?	Metric Impact?	Operation Applicable?	Metric Impact?	Operation Applicable?	Metric Impact?
Inspection	1	0	1	0	2	0
Testing	2	1	1	1	1	1
Servicing	1	1	1	1	2	1
Lubrication Alignment Adjustment						
Calibrarion	0	0	1	1	2	1
Replacement	1	1	1	1	2	1
Repair	2	1	1	1	1	1
Major Re-Work	0	0	0	0	1	1
Overhaul Rebuild Modification Modernization Conversion						

Applicable?

0 - No
1 - Yes
2 - Inferred

Metric Impact?

0 - No
1 - Yes

Repair. Metrication will affect training, documentation, and tools requirements for repair operations in much the same fashion as for replacement. However, repair operations imply more complex tasks and the need for greater expertise. Therefore, training and documentation requirements imposed by metrication would be more stringent. Tools requirements would be more general -- sets of tools (rather than individual pieces), as well as infrequently used common metric tools. The availability of materials would also be a factor. At some point, inch materials (including common parts, such as fasteners) will begin to disappear, affecting the repair of customary equipment; non-availability of metric-sized materials early in the transition could similarly affect repair of metric equipment.

Major Re-Work. Sophisticated maintenance operations which are performed at the depot level (overhaul, rebuild, modification, modernization, conversion) will be affected by metrication, essentially as magnitification of the impact on repair operations. In addition, metrication may affect the facilities and special TMDE needed to perform these operations.

Panel Assessment

Testing activities will require dual capable TMDE equipment and increased training effort throughout the changeover period. Problems connected with identification of parts will be minimal, no different or greater than those currently experienced. Testing and servicing will be dependent on the availability of publications giving data in the appropriate units. Introducing metrics in new systems or modules, with SI documentation, is expected to minimize this documentation problem. The introduction of metric equipment will bring about a need for additional training to ensure the correct use of tools and TMDE. The panel noted that the level of intelligence, education, language capability, training, and experience of the expected volunteer force gives reason for considerable concern in this regard.

The calibration aspects are almost identical to those discussed in connection with testing and servicing. Another factor mentioned, however, concerned the difficulties arising from rarely procured items, especially those procured directly from commercial sources. In this case, there may be an inability to identify overall system quantities and types. Again, this is not a problem peculiar to metric conversion but one which conversion may aggravate.

In considering repair, replacement and rework, the panel noted that training problems similar to those discussed above are likely. Furthermore, metrication will affect the criteria (such as cost, availability, timeliness) by which repair/replacement decisions are taken.

CHAPTER 3

IMPACT OF METRIC CONVERSION ON QUALITY ASSURANCE AND TESTING AND EVALUATION ELEMENTS OF THE ARMY LOGISTICS FUNCTION

The purpose of this section is to discuss the impacts of metric conversion on the Quality Assurance (QA) and Testing and Evaluation (T&E) elements of the U. S. Army logistics function. To the extent that QA and T&E are related, metric impacts will be similar in each area. This discussion first focuses on the metric impacts common to QA and T&E activities, then unique aspects of T&E will be treated.

Definitions. In order to conduct this analysis of QA and T&E, definitions of these two activities were required. The concepts or definitions utilized in the analysis are as follows:

1. Quality Assurance: The function of management by which conformance of materiel to contract and specification requirements is assured. This assurance is obtained by evaluation of production quality controls and inspections exercised by procedures, supplemented by direct verification inspection of product.*

2. Test: A process by which data are accumulated to serve as a basis for assessing the degree that a system meets, exceeds, or fails to meet the technical or operational properties ascribed to the system.*

3. Evaluation: A subjective determination, accomplished jointly by the several major subordinate commands of the utility, that is, the military value, of a hardware item/system--real or conceptual--to the user.*

*AR 310.25, Dictionary of United States Army Terms, April 12, 1977.

Analytic Approach. The approach used in analyzing these aspects of the logistics function has been to determine what inputs/mechanisms are required to provide quality assurance and testing and evaluation of Materiel, Services, Supplies and Data (Quality Assurance categories). The inputs/mechanisms identified are listed in Figure 2. An analysis has been conducted to determine which of these inputs/mechanisms would be affected by metrication and the type of impact anticipated for each quality assurance category (DoDD 4155.1). No attempt has been made to gauge magnitude of impact of metrication; impact will vary according to which type of material or supply item, for example, is being considered.

The inputs in Figure 2 are required for each category of activity and for each QA category being examined. The discussion concentrates on major decision points and the nature of metric impacts which could occur.

COMMON IMPACTS OF METRIC CONVERSION ON QA AND T&E

Following this framework, Figure 3 contains a binary matrix, with an X indicating an area of potential impact due to metrication. These potential impacts are discussed by QA category.

MATERIEL

In our analysis of materiel QA and T&E activities, we have examined the metric impacts for both new development and materiel in question. In general, existing QA or T&E specifications, standards, or requirements documents will require conversion--either hard or soft, depending on the situation. In cases of new items in the initial stages of acquisition, new standards, specifications and/or requirements, in SI units, may be required.

FIGURE 2

INPUTS/MECHANISMS REQUIRED FOR QA AND T&E

1. Specifications, standards, and/or requirements.
2. Procedures
3. Test equipment
4. Facilities, including test equipment which is an integral part of the structure
5. Personnel who are adequately trained to perform the tasks required.
6. Adequate planning, coordination and timing of activities.

FIGURE 3

POINTS OF POTENTIAL METRICATION IMPACT ON U. S. ARMY QA AND T&E LOGISTICS FUNCTIONS

	Quality Assurance					Testing and Evaluation				
	Specs, Require-ments	Proce-dures	Equip-ment	Facili-ties	Person-nel, Training	Specs, Require, ments	Proce-dures	Equip-ment	Facili-ties	Person-nel, Training
Materiel	X		X		X	X		X		X
Services	X		X	X	X	X		X	X	X
Supplies	X		X		X	X				
Data*					X					X

*Other impacts are discussed in the text.

If existing standards, specifications, etc. are soft converted, caution must be exercised to assure that conversion of a measurement to SI does not indicate an unwarranted degree of accuracy or precision. For example, 100 ft. is 30.48 m. Two decimal place precision which may not be necessary and may not be measurable with available equipment.

Equipment. In the early phases of metric conversion, an important aspect of planning will be the consideration of the availability of appropriate measurement instruments for conducting QA and T&E activities. Measurement instruments encompass devices ranging from scales and rulers to large, sophisticated measurement equipment to expendables such as pressure gauges used in ammunition testing. It is probable that solutions to some needs are simple, e.g., use of conversion tables or paste on labels. Some equipment may already measure in SI and other measurement instruments may have to be acquired. These are all aspects which should be considered and planned for.

As the discussion above indicates, soft conversion of existing standards and specifications for QA and T&E must be considered carefully to assure that unwarranted precision is not the result. If this is not handled with care, the result could be the generation of a need for higher precision instruments for conducting QA and T&E activities, in a situation where higher precision instruments (and therefore the added costs) are not necessary.

Other impacts of metric conversion on QA or T&E equipment could include:

1. Need for modification of test fixtures.
2. Need for new calibration equipment so that new test equipment can be checked.
3. Revision of old Instruction/Operation Manuals for equipment which is modified for metric use and development of new manuals for new metric-only equipment.

Facilities. By definition, facilities include physical structures and measurement and testing devices which are an integral part of the structure. Thus metric conversion will have potential impacts on facilities in much the same manner as the impacts on equipment described above.

Personnel and Training. The introduction of new or modified test or QA equipment and new requirements or standards will lead to a need for personnel adequately trained in the metric system to conduct QA and T&E, operate equipment, and maintain equipment, facilities, etc. The need for metric awareness is substantial while the need for formal metric training will vary in relation to the materiel, the nature of the QA or T&E task, and the background of the personnel.

SERVICES

Services, in this context, encompass calibration and metrology services. The impacts of metrication on QA and T&E services may include:

1. The need for new or modified specifications, standards and requirements;
2. The need to acquire new SI calibration equipment;
3. The need for modification of existing facilities or construction of new facilities;
4. The need for trained personnel to operate and maintain new calibration equipment.

The requirements for calibration equipment are related to the type of QA and T&E equipment used. Thus the impact of metrication on calibration equipment is dependent on decisions made in dealing with T&E and QA equipment required for metrication. For example, if a decision is made to modify existing T&E or QA equipment so that it provides dual readouts, the impacts on calibration services is negligible. However, if new SI only equipment is acquired, the demands on calibration services will be greater.

Currently, the National Bureau of Standards provides calibration services to the U. S. Army. This study, however, indicates a decline in the services provided by NBS and national metric conversion may increase the burden on NBS at a time when it is unwilling to expand calibration services. This could create additional burdens on the U. S. Army calibration services. The magnitude of each of these impacts is dependent upon the magnitude and pace of change over to metric, and decisions regarding TMDE (Test, Measurement and Diagnostic Equipment).

SUPPLIES

Supplies are stored items. At this stage of the life cycle, quality assurance activities are performed more frequently than are T&E activities. Thus the discussion will focus primarily on the impact of metrication on Supply QA; T&E impacts will be similar, but minor.

The impacts of metric conversion on QA of supplies are similar to those described in the discussion of materiel. Metric conversion will require appropriate QA standards and specifications, SI measuring devices, and trained personnel to conduct QA tests needed and maintain the equipment. Also necessary may be new or modified operating manuals and instructions. Thus when an item is pulled out of storage for QA, testing must be conducted in the original units of measurement to ensure comparability. For customary dimensioned items, this will require the availability of appropriate measurement equipment (either customary or dual readout) and the retention of appropriately dimensioned standards and specifications, even after metric conversion is well under way.

DATA

One of the purposes (and results) of QA and T&E is the collection of data which can be used for a variety management purposes. For example, historical data are used to project performance trends and as inputs to the subsequent development of standards and specifications.

The conversion to metrics may, at some point, affect records and reports and cause a discontinuity in the data base, making historical comparisons difficult. As alluded to above, data discontinuity could be a problem in conducting QA on supplies. It will also have an impact on the automated data processing system which will have to be programmed to accept SI inputs. As some U. S. and Australian firms and this report have pointed out, this can lead to data field size or data storage problems.

The problem of unwarranted precision, especially in the case of soft conversion, will emerge. Policy guidelines for soft conversion and data use must be developed. Attendant upon these elements too, will be the need for metric awareness training and specific training in some cases.

UNIQUE IMPACTS OF METRICATION ON T&E

Viewed in the context of life cycle management, the impact of metrication on testing and evaluation may be identified at the various development/operational test points. Figure 4 shows the elements of development and operational testing as described in AR 70-10. Areas where metrication impacts may be expected are indicated by Xs opposite T&E test points (DT I, DT II, etc.). The nature of these impacts is discussed in the following paragraphs.

Design Risks. As part of the analysis of design risks to be made at DT I, consideration would have to be given to the availability of metric standards, specifications, and materials. Projections or forecasts of the availability of these items, related to the project development schedule, would have a significant impact on the decision to proceed with the development as a metric design.

Component Interface Problems. Component interface problems deserve careful consideration at DT I regardless of the measurement system employed. During the transition, interfacing of new wholly metric or hybrid product designs will require increased attention. Wholly metric or hybrid product improvements to existing designs will add yet another dimension to interface problems. Interface problems can

FIGURE 4

METRIC IMPACTS ON DEVELOPMENT AND OPERATIONAL TESTING

DEVELOPMENT TESTING

Elements of Development Testing	Design Risks	Potential Application of Technology	Component Interface Problems	Equipment Performance Capability	Production Feasibility	Technical Performance
DT I	x		x			
DT II and DT III					x	

OPERATIONAL TESTING

Elements of Operational Testing	Military Utility Estimates	Potential: New vs. Existing System	Need for Modication	Adequacy of Doctrine and Maintenance Support
OT I, OT II, and OT III	x			x

x = Areas of metric impacts.

be expected to increase during the transition as more and more wholly metric or hybrid systems are introduced; however, interface problems related to joint manufacture/Allied use of the system may be eased somewhat by adopting metric designs.

Production Feasibility. At DT II and DT III the metric emphasis, particularly early in the transition, would be on production feasibility, i. e., the assessment of the readiness of the involved industries to manufacture the new system at acceptable levels of production, quality, and cost. The production feasibility problem can be expected to diminish as industrial conversion to SI progresses. Until industrial conversion is complete, however, the feasibility of producing hybrid designs, which reflect the state of industrial metrication, may be significantly better than the feasibility of producing wholly metric designs.

The nature of metrication impacts on operational testing would be essentially the same at OT I, OT II, and OT III; differences would lie only in the depth or level of detail involved. As Figure 4 indicates, metrication would affect several military utility criteria and various aspects of the adequacy of doctrine and maintenance support.

Military Utility Estimates. Metrication would affect assessment and operational testing of the military utility (compatibility, interoperability, maintainability, supportability, and training requirements) of a new system in the user's environment. These considerations will inevitably increase in significance where a new wholly metric system is to operate in conjunction with customary equipment. The effect of new hybrid equipment could be less predictable; compromises which minimize changes for the operator might aggravate support problems, for instance.

Adequacy of Doctrine and Maintenance Support. Metrication would affect operational testing and evaluation of the adequacy of maintenance support and training (i.e., Integrated Logistics Support (ILS)) for employment of a new system. Most of the elements of ILS (described in Figure 5) will be affected by metrication, and

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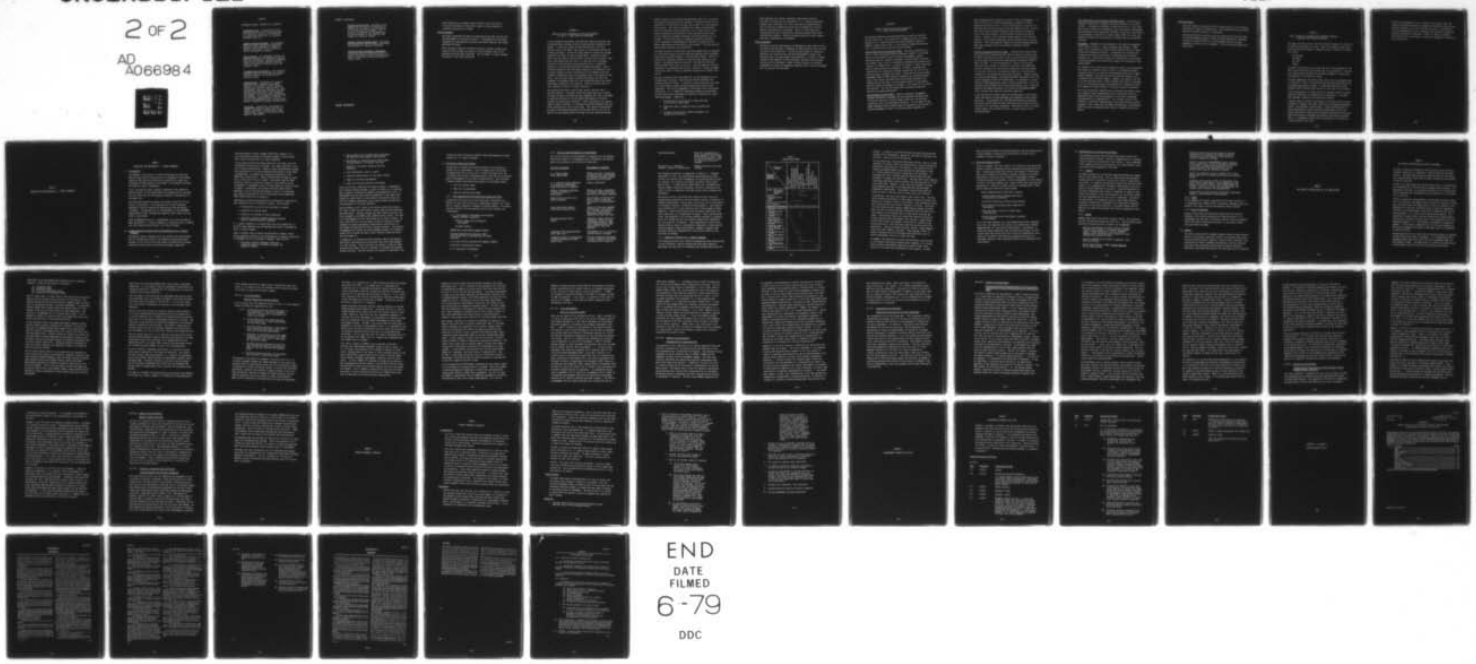

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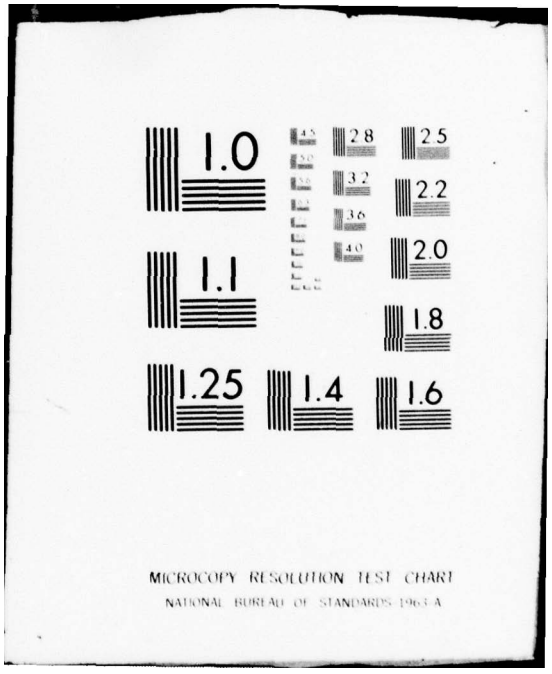
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FIGURE 5

INTEGRATED LOGISTIC SUPPORT (ILS) ELEMENTS

Maintenance plan. A description of the requirements and tasks to be accomplished for achieving, restoring or maintaining the operational capability of a materiel system or facility.

Support and test equipment. All equipment, mobile or fixed, required to support the operation and maintenance of a materiel system or facilities at all locations to which a deployment is planned.

Supply support. All management actions and execution necessary for determining requirements for acquisition, cataloging, packaging, preservation, receipt, storage, transfer, issue, and disposal of both principal and secondary items.

Transportation and handling. The procedures, equipment, and facilities used for packing, crating, handling, and transportation of materiel system.

Technical data. Encompasses all types of specifications, standards, engineering drawings, instructions, reports, manuals, tabular data, and test results used in the development, production, testing, use, maintenance, demilitarization, detoxification, and disposal of military items, equipments, and systems. Not included in technical data are financial, administrative, cost and pricing, and management data, or other information incidental to contract administration.

Facilities. Construction requirements to support the materiel system involved, for example, buildings, concrete pads, revetments, roads, runways, utilities and other peculiar requirements.

FIGURE 5 (Continued)

Personnel and training. Personnel in the numbers and with the skills necessary to operate and to support a materiel system in its operational environment. The processes, procedures and equipment used to train personnel in the operation and support of a materiel system.

Logistic support resource funds. The funds required for the identification, acquisition and management of logistic resources.

Logistic support management information. Information used for the analysis and for reporting of actions taken or required to be taken in developing or executing logistic support plans.

Source: AR 700-127.

would therefore be a proper concern of OT&E at all test points. The nature and extent of the metric impact on these elements is discussed throughout this report.

Panel Assessment

The panel recognized the need to synchronize QA and T&E training with the development of new metric materiel. Interoperability, and interchangeability requirements associated with hybrid materiel may impose additional QA tasks.

While the panel views the transition period as lengthy, proper a-plication of the ILS model can reduce, if not eliminate, many of the problems which have been discussed. The ILS model, in fact, provides the means to facilitate conversion.

CHAPTER 4

IMPACT OF METRIC CONVERSION ON TRAINING ELEMENTS OF THE U. S. ARMY LOGISTICS FUNCTIONS

In the foregoing discussions, the potential need for personnel who are appropriately trained in metric usage has been frequently mentioned. In the early phases of metric conversion, this will certainly have to be taken into account in the decision-making and planning processes. During the later phases of conversion, younger personnel are likely to have received metric training in public school and the need for special metric training will decrease. However, 15-20 years from now, the U. S. Army may have to provide training in the inch-pound system because the U. S. education system will be providing only metric-trained individuals. That a training program for the inch-pound system will be required is not in doubt; properly trained individuals will be needed to service customary dimensioned long life equipment which is currently in the field. But decisions today to design and produce new long life equipment in customary units will only extend the period over which inch-pound training will be required. From the training point of view, adoption of metric is highly desirable.

The preceding discussion implies that "metric training" has a specific meaning. The reader should note that there are a variety of levels of metric training and that judgments will have to be made at each decision point as to the depth and breadth of training required in a particular situation. "Metric awareness", the lowest level of metric training, is a program to develop awareness that the metric system exists and is being used. This type of program would be aimed at developing awareness and the same facility for use of metrics as the average person has today with the inch-pound system.

Scope of metric training above the awareness level will, of course, vary greatly depending upon the extent of functional metric ability required by an individual to do his job, as well as his background and training. Thus while an engineer will need a sophisticated level of functional metric capability, it is likely that his background, education and training will have provided him with most of the requisite knowledge; additional training required will be minimal. On the other hand, an automotive mechanic may need a fairly substantial understanding of the metric system, but his metric experience may be minimal or non-existent. Training requirements would, therefore, be significant.

The need for metric training that would be brought about by adoption of a new metric design or metric measured supplies must be weighed, along with many other factors, in the decision process. This is a particularly important question to consider when assessing a new design. New designs mean new training. One question that the decision-maker should bear in mind is: Does the adoption of metric dimensions in the design significantly increase or change the magnitude and/or level of training required throughout the product life cycle?

One key to assessing training needs will be the management policy towards metric training. DoD Directive 4120.18 addresses the training issue as follows: "Training in metric practices and usage will be provided to those personnel whose duties require such knowledge." This policy statement is broad and allows considerable flexibility. U. S. industrial experience suggests three guiding policies which have contributed to effective, minimum cost, metric training programs. These are:

1. Provide metric training only to those who need it to carry out their jobs.

2. Teach only what is needed to know to perform the job.

3. Provide training shortly before knowledge is to be applied, on the job.

Many companies also provide voluntary, after-hours training, available for those who are interested. U. S. industry experience suggests that training at all levels may best be accomplished by the utilization of modules which can be put together to suit the needs of the persons to be trained. The U. S. Army might also investigate the use of commercially available modules rather than starting from scratch. Industry-prepared modules for metric awareness may be appropriate, for example.

Panel Assessment

The Army's training requirements are dependent on the extent of Army metrication and the metric competence of Army personnel which will be low early in the transition. During the early phase of conversion, perso-nel will need facility with both measurements systems, but overtime, metric training needs should decrease. In order to assure responsive and adequate training programs, periodic training needs analyses must be conducted. Based on these analyses of personnel competence and levels of competence required, metric training programs must be designed and developed.

CHAPTER 5

GENERAL METRICATION IMPACTS RELATED TO U. S. ARMY LOGISTIC FUNCTIONS

The preceding sections discussed metrication impacts on specific logistic functions. This section will attempt to paint a broader picture of U. S. Army functions that could adversely impact on DARCOM's logistic activities, if not properly recognized and dealt with in the planning and decision making process.

Table Organization and Equipment (TOE). While the responsibility of U. S. Army Training and Doctrine Command (TRADOC) is to develop TOE(s) for new materiel and for product improvements, metric decisions taken by a materiel developer, without proper interface with TRADOC, could result in improperly organized and equipped units. Likewise, if TRADOC fails to consider the impact of metric decisions made by HQDA and materiel developers, on TOE(s), inappropriate organization and inadequate equipment inventories for units to be provided metric equipment may result. While the Life Cycle System Management Model (LCSMM) contains procedures to preclude misadventures, until metric considerations are routinely handled by all elements within the Army, it would appear logical for any metric decision process introduced to include, in its checklist of actions, the question: "Has the TOE impact been evaluated by both the materiel and combat developers?"

New Equipment Training (NET). Special contractual agreements between the materiel developed and the contractor developing the item may be required to ensure proper training of the test and evaluation, user, and maintenance personnel. In this phase of the LCSMM, emerging training needs should be conveyed to the trainer to enable development of metric training programs responsive to

newly developed metric materiel or metric product improvements. In view of OSD stress on NATO standardization, adoption of NATO-developed materiel by the U. S. Army might provide a training program data base which may simplify NET and TRADOC training. As with TOE, the Life Cycle System Management Model contains procedures which, when done properly, should consider the matter of metric impacts. However, until completely second nature in the decision process, it may prove advantageous during the NET phase to ask the question: "Have the potential impacts on training program development been evaluated by both the materiel developer and the trainer?"

Military Occupation Specialty (MOS). Interface activities between the materiel and combat developers and the trainer resulting from DA metric decisions must occur as early as the Preliminary Qualitative and Quantitative Personnel Requirements Information (PQQPRI) phase of LCSMM. If the consequences of a metric decision are recognized early enough in the metric transition, the PQQPRI may provide a mechanism for planning and scheduling training programs with trained instructors to ensure availability of trained user, operational, and testing and evaluation personnel. Outputs related to training requirements, resulting from metric decisions, will also provide important inputs to the MOS phase. As indicated in discussions of LCSMM phases above, early in metric transition, it will be profitable during PQQPRI and MOS decision-making to ask: "Have the materiel and combat developers, the trainer and DCSPER/MILPERCEN fully evaluated the impact of the metric decision?"

A less obvious but critical aspect of the MOS phase is the need to ensure that metric trained personnel are assigned to metric equipped units. To accomplish this, the MOS qualification system must be able to readily identify those individuals with metric training and skills in a particular specialty. Until metric skills, at appropriate levels, are universal in the U. S. Army, this will be a serious problem.

Test, Measurement and Diagnostic Equipment (TMDE). Long lead time equipment constitutes a budgeting and timing problem in the LCSMM process. A premature procurement of TMDE might result in the subsequent need to modify that equipment by the time materiel development had progressed to the stage where the TMDE is required. Additionally, the procurement of new metric or dual capable TMDE, will place new demands and these must be assessed on the metrology and calibration services.

Management. Attendant to the foregoing is the need for management at all levels of the U. S. Army to address the question: "What impact will the decision to make a metric product have on my phase of the decision-making process?" In answering this question consideration would have to be given to timing/phasing, interface problems, etc. Metrication success will be measured by and depend on the thoroughness with which metric impacts are considered in the LCSMM process.

For example, while analyzing the problem of supply, we have examined the problem of inventory control, which is a management problem. Inventory control is an activity which permeates the entire supply support element of the logistics function and would appear to be a potential point of metric impact. However, our analysis has led us to the conclusion that if metric impacts are properly considered at all of the decision points discussed earlier, inventory control will present no unique problems in relation to metric conversion.

During the transition, opportunities to minimize the adverse logistics impacts of dual equipage may exist at the policy level, by keeping the metric and inch equipment, in the field, separated organizationally or geographically. For instance, early in the transition, particular organizational units might be solely metric equipped. Later, when metric equipment predominates, consideration might be given to equipping whole Armies or theaters solely with metric.

Panel Assessment

The panel generally concurred with the issues raised at the foregoing discussion of general considerations. They recognized that the effect required for LCSMM planning is significant.

During the transition the Army must have personnel who are proficient in both measurement systems in order to ensure operational readiness. A facility to function well in two measurement systems has been compared to thinking in two languages. The training implications are significant.

CHAPTER 6

PANEL CONCUSIONS CONCERNING MOST IMPORTANT PROBLEMS CONNECTED WITH METRIC CONVERSION

The panel was asked to move from the individual aspects of conversion to consider the system as a whole. From this viewpoint, the logistics functions were ranked in descending order of severity of impact as follows:

Maintenance
Training
QA, T&E
Supply

No general conclusions can be drawn from this ranking because of the small size of the panel and limited time for consideration. However, this ranking does represent the considered judgment of individuals knowledgeable in the logistics field.

The panel emphasized the difficulties likely to be encountered early in transition. Early in transition there are many uncertainties and such great resistance to change. As experience develops, these problems should subside rather quickly to the level of the routine.

Fiscal constraints on the Army are seen as another reason to ensure that Army conversion is conducted on a planned basis, in harmony with national, industrial and educational sectors.

Problems areas of greatest significance to the panel relate to dual stockage of fasteners and repair parts and to maintenance equipment (tools, test equipment, publications). Other considerations of great importance are those concerned withreadiness criteria for reserve and National Guard units and those associated with the strategic positioning of equipment and supplies, particularly outside the U. S. Dependence on host nation contractors is not seen as a viable solution in war time.

Finally, top management is not involved at the present time, yet effective conversion requires a management orientation toward change. Lacking involvement and prior planning, the panel is apprehensive that over-management or crisis management may someday be imposed as national metrication accelerates. There is a need to recognize that metrication is inevitable, to establish commitment to conversion and to begin work.

ANNEX J

GUIDELINES FOR MONITORING U. S. METRIC PROGRESS

ANNEX J

GUIDELINES FOR MONITORING U. S. METRIC PROGRESS

J.1 Introduction

The purpose of this annex is to outline the means by which the Army can keep track of metrication as it progresses in the United States so that decisions affecting the acquisition, supply and maintenance of Army materiel can be made in the context of current and realistic metric information.

First, the need for metric progress information with respect to decision points in the system acquisition process will be explored. This will help focus on the important elements of monitoring in a conceptual way.

Next the whole monitoring concept and process itself will be discussed in some detail. This discussion will draw on material presented in earlier reports and observations from the general literature. The emphasis will be predominantly on the DA/DARCOM organizational level, although the impact on other levels will be cited in less detail.

Some recommendations which, if implemented, will allow the Army to begin to monitor U. S. metric progress as a requisite step in keeping pace with industrial metrication, will then be listed.

J.2 System Acquisition Process and Its Relationship to U. S. Metric Progress

The need for metric information will be directly and significantly felt at the decision points in the DoD/Army systems acquisition process; it will also be felt with regard to acquisition processes which do not fall within the purview of systems acquisition.

Confining remarks to major systems acquisition, however, will serve the present purpose of focusing on aspects of metrication which relate to monitoring U.S. metric progress.

In the system acquisition process there are, of course, many considerations and decisions to be made. In a sense, metrics is only one of these considerations. However, since the measurement system used (particularly a new one) undergirds and affects so many other considerations, it warrants the attention conferred on it by DoDD 4120.18 and AR 700-1. Metric decisions must be made at every point in the early life of a system. Once taken, some of these decisions (such as a decision to design in hard metric) may be irrevocable, or changeable only at a heavy penalty in terms of costs or delays. Furthermore, the premise from which DoDD 4120.18 emanates is not to initiate new designs in metric if convenient, but rather to prescribe SI for all new designs unless demonstratable reasons exist for not doing so.

Some metric conversion considerations are essentially questions of the suitability of an SI product or system. These concern:

- Projected Allied use of the new product or system
- Potential for foreign sales
- Potential for foreign or joint production
- Potential to enhance defense-industry preparedness or defense production readiness

U. S. metric progress is a concern here, but only secondarily; in the main these questions can be answered with minimal knowledge of the U. S. metric status.

There is another class of metric considerations, however, which raises questions relating to the technological or economic feasibility of proceeding with an SI product or system. These include:

- The state of metric readiness within the industries which will develop or produce the product or system.

- o The availability of suitable metric standards and materials, both domestic and foreign.
- o Development or production delays which might be occasioned by a "Go Metric" decision.
- o Impact of a new metric design on quality assurance.
- o Cost differential, inch vs. metric.
- o Logistics implications of a new metric design.
- o Impact on training requirements.
- o Short and long term benefits anticipated.

These are difficult questions for several reasons: knowledge of the situation outside the Army, as well as within it, is required; that situation is essentially dynamic and probabalistic (e.g., a development decision today implies production in the future--will industry be ready then? on what terms?); metrication costs are difficult enough to determine, what criteria should be applied to the assessment of life-cycle benefits?

Decision-makers at all levels of the system acquisition process will have to deal with metrication issues, some of which have been mentioned above. Project managers and their staffs certainly, but also reviewers at the DSARC and/or ASARC decision points, will have to be knowledgeable of the implications of any metric project. No less significant will be the impact of metric projects on normal (opposed to project management) organizations, particularly as the number and magnitude of metric projects increase. The logistic arrangements for a major and widely deployed system, for instance, cannot fail to affect the Army's total logistic system and those who must manage it.

To summarize, the foregoing briefly presents some of the complex metrication considerations and questions with which Army managers will have to deal. Useful solutions and answers to many of these questions have begun, and will continue, to originate and develop outside the Army. The next section will explore in some detail the

process by which the Army can monitor these developments and other aspects of U. S. metric progress.

J.3 Monitoring Concept and Process

We must have a concept for monitoring before we can describe a process for its achievement. We will proceed from 2 principles: the monitoring task is too big for a single individual and, the individual with a metric problem/question is the best one to monitor metric developments in his area of responsibility. The following elements comprise the monitoring process in the broadest sense:

- Who will monitor whom?
- What will be monitored?
- How will monitoring be done?

J.3.1 Army Organizations with Monitoring Responsibilities

Considering first who will do the monitoring, information on a subject as basic and pervasive as a measurement system is of interest to virtually everyone, although in varying degrees. The organizational entities with the greatest need to know, however, are listed below:

U. S. Army Materiel Development and Readiness Command (DARCOM), especially

Office of Deputy CG for Materiel Development

DA Metric Office

DARCOM Major Subordinate Commands (MSCs)

Program/Project/Product Managers (PMs) (for current metric projects and all future projects)

U. S. Army Training and Doctrine Command (TRADOC)

DA Office of Legislative Liaison

U. S. Army Corps of Engineers

J.3.2 Entities and Developments to be Monitored

The list of entities to be monitored is extensive, but the aggregations below reduce it to manageable size; information and developments to be monitored are also briefly described.

ENTITIES TO MONITOR	DEVELOPMENTS TO MONITOR
U. S. Metric Board (When established)	Federal policies, regulations and plans; plans and proposals of industrial sectors; social constraints and attitudes
U. S. Congress (House Committee on Science and Technology; Senate Committee on Commerce)	Federal legislation
Federal Interagency Committee on Metric Policy (if established)	Federal policies, regulations and plans; impact of national metrication on Federal agencies
Other Military Services and Defense Agencies	DoD policies, directives and plans; impact of national metrication on Defense Department
State and Regional Metric Coordinating Organizations	Impact of state laws (weights and measures, land measures, etc.) on Army activies and operations; State metric education policies and plans
American National Metric Council	Industrial sector plans and timetables; impact on Army procurement activity; industrial rationalization (preferred metric sizes and modules)
Standards-Writing Organizations (ISO, ANSI, etc.)	Development of U. S. and international metric standards
Standards Groups of International Military Organizations (NATO, CANUS, etc.)	Military standards development related to materiel for Allied use and/or joint production

Trade Associations	Plans for introduction of metric materials and modules, preferred metric sizes, inch-SI cost differentials; industry conversion plans and progress
Particular U. S. Companies (vendors, suppliers, contractors)	Company conversion plans and progress

The foregoing discussion is summarized in Figure J-1. Although some detail is lost, the relationships among monitoring organizations, and entities and developments to be monitored may be seen at a glance. For instance, the Central DA Metric Office would monitor the U. S. Metric Board (among others) for information concerning Federal legislative proposals, policies, regulations and plans, as well as industrial and other sector plans, proposals and timetables.

Monitoring activity associated with foreign military sales and foreign/joint production of Allied materiel involves, in addition to standards development, foreign legal restrictions on the importation of non-metric products, including military materiel. Such restrictions already exist in some countries and in the European Economic Community. These restrictions are not currently significant, but their importance will progressively increase. Other considerations aside, the acceptability of military materiel designed in customary units will become less and less assured, whereas this impediment will not exist for SI materiel. Army organizations involved with foreign military sales or foreign/joint production of Army materiel should be aware of these restrictions, although it appears that principal monitoring responsibility lies with the Office of the Secretary of Defense.

J.3.3 Methods of Monitoring U. S. Metric Progress

The foregoing sections have identified appropriate Army organizations to act as monitors, entities outside the Army which should be monitored, and the kinds of information and insights which each can

FIGURE J-1

MONITORING PROCESS SUMMARY

ARMY ORGANIZATIONS WITH MONITORING RESPONSIBILITIES / ENTITIES TO BE MONITORED	U. S. Metric Board	U. S. Congress	Federal Interagency Metric Group	Other Services, Defense Agencies	State and Regional Organizations	Council of State Governments, etc.	AMC Sector Committees	General Conferences	Standards Groups - ISO	ANSI	Others (AIA, SAE, IEEE, etc.)	International Military Standards Groups	NATO, CANUS, etc.	Involved Allies/Nations	Trade Associations	Selected Companies
DARCOM: Materiel Development Staff				x			x	x	x	x			x			
Central DA Metric Office	x		x				x	x								
DARCOM MSCs				x			x	x	x	x	x				x	x
Program/Project/Product Managers														x	x	x
TRADOC				x	x	x	x	x								
DA Legislative Liaison Office		x														
Corps of Engineers					x	x		x								
DEVELOPMENTS TO BE MONITORED																
Federal Policies, Regulations and Plans	x		x													
Sector Plans, Proposals, Timetables	x						x	x							x	
Social Constraints and Attitudes	x	x					x	x								
Federal Legislation		x														
National Metric Impact on Federal Agencies			x													
DoD Policies, Directives and Plans				x												
National Metric Impact on Defense Department				x												
Impact of State Metric Laws on Army					x	x										
Metric Education Plans and Progress					x	x		x								
Impact on Army Procurement Activity							x									
Industrial Rationalization							x	x								
Standards Development and Adoption							x	x	x	x	x		x	x		
Metric Materials Availability, Preferred Sizes, Costs							x	x							x	x
Company Conversion Plans and Progress								x								x

provide. It remains to outline the means by which the monitoring process can be implemented. Basically, two modes of operation are possible: passive or active monitoring.

For the time being, the passive mode would suffice; there is little necessity for action, other than subscribing to various metrication periodicals and attending a few meetings. Most agencies of the federal government appear to be awaiting the appointment of the U. S. Metric Board and specific guidelines from the Board. In following this plan, the Army would be moving (some would say drifting) in concert with the nation. The Army would avoid imposing significant additional tasks on persons for whom metrication is not a principal duty. However, if this plan were adopted, the Army would probably miss many of the opportunities and advantages presented by metrication. The process of metrication would be drawn out and, in the end, would be more costly and difficult.

Alternatively, the Army could assume a more active role. The Army could establish and maintain a wide range of external contacts, not merely as an observer, but as a participant in the standards-writing and rationalization activities of concern to the Army. Participation also implies active two-way communications whereby the Army, while gaining first-hand industry information would be able to inform industry at the working level of Army metric planning and needs. Participation would help reduce the transition period by closely coupling Army requirements with industry's capabilities; participation would also suggest initiatives for catalytic Army actions and ways in which the Army might realize the benefits of metrication. Active participation would, however, impose demands (time and travel funds) on the Army. These demands, would, in effect, represent the cost of keeping pace and having a say in metric developments which will affect the Army.

In summary, the alternative to active participation, particularly as the national metrication movement gains momentum, is to simply react to metric developments imposed by external forces which likely will not take Army considerations into account. We feel

that active participation (including effective two-way communication) in those aspects of national metrication where the Army has an interest is clearly indicated.

J.4 Intra-Army Communications

There is, however, one vital element still missing in the monitoring process--internal communications and information exchange within the Army. Because many people must monitor the aspects of metrication which are of general or particular interest to others in the Army organization, there must be an effective interchange of metric information among all concerned. Metric developments in one industry, or even in one large company, will usually affect more than one Army organization. There are a number of ways to exchange metric information among and within Army organizations:

Formal Communications (Directives, Letters)

Informal Communications Between Metrication Coordinators and Contacts

Publishing Directories of Metrication Contacts

Publishing Bulletins/Newsletters Dedicated to Metrication

Publishing Metric Articles in Other House Organizations

Holding Army Metrication Conferences, Seminars and Workshops

All of the above methods, and intra-command metrication committee activities, are important and useful, but unconstrained informal communications will best assure effectiveness. Furthermore, it should be clearly understood that the monitoring process, as well as most other metrication functions, should be predominantly undertaken by line people--those who must implement metrication in the normal course of their responsibilities--not by dedicated staff "metricators".

J.5 Implementation of the Monitoring Process

The preceding sections have discussed the salient aspects of a viable monitoring process. Specific recommendations for implementing the process are contained in this section. These recommendations, except the first, are directed at the organizational level one echelon below Department of the Army.

J.5.1 General

The ANMC represents by far the most important metrication contact point at the present time. The U.S. Metric Board may eventually assume some of its functions, but that will occur at some time in the future. To establish and maintain contact with national metrication, it is suggested that the Army be represented on as wide a range of sector committees as possible. Since representation on the sector committees does require a commitment in terms of time, travel and expense, it may not be possible, as a practical matter, for Army representatives to serve on all committees. Therefore, the Army should, in conjunction with the other Armed Services, arrange for appropriate representation on committees of greatest importance to the various Services. Provisions should then be made for the rapid and sustained inter-service exchange of information.

J.5.2 DARCOM

DARCOM, specifically the Central DA Metric Office, will perform a key role for the Army during the transition. The following actions relating to monitoring metric progress are recommended:

Maintain the Directory of Metric Contacts (DARCOM Circular 700-4 Series) in a complete and current state, listing commercial as well as AUTOVON numbers; freely distribute the directory to interested parties outside the Army.

Publish a DARCOM Metric Bulletin frequently, with wide distribution.

Obtain subscriptions to ANMC's Metric Reporter for all MSCs and PMs.

Establish Army ad hoc working groups to exchange information on government and commercial metric conversion plans and progress in the industrial fields of interest to the Army.

Convene a meeting of DA/DARCOM/MSC metric coordinators to obtain their inputs to the monitoring needs of the Army, to propose the composition of the above-mentioned ad hoc working groups, and to surface other areas of interest or concern.

Assure that effective action is taken to fill information gaps which are discovered by the ad hoc working groups.

Encourage participation by MSCs on appropriate standards-writing organizations, trade associations, and metrication planning bodies, such as ANMC Sector Committees. Develop a plan for such participation, including travel funding, with affected MSCs.

Convene Army and Army/industry metrication conferences, seminars, and workshops as needs develop.

J.5.3 TRADOC

As the Command with primary responsibility for Army training, it is recommended that TRADOC monitor state metric education plans and progress, and federal policies and monetary grants therefor.

J.5.4 Corps of Engineers

Because of the close and continuous contact which the Corps of Engineers (Civil Works) maintains with state activities, it is recommended that the Corps of Engineers monitor metric developments (other than metric educational progress) in the several states which may affect the Army.

J.6 Summary

The need to monitor metric progress becomes evident at many decision points in the systems acquisition process, particularly where questions arise which concern industry's state of metric readiness, the availability of metric standards and materials, and the short and long term costs and benefits associated with metric decisions. Manifestly, many Army organizations and individuals will be required

ANNEX K

THE IMPACT OF METRICATION ON ARMY REGULATIONS

ANNEX K

THE IMPACT OF METRICATION ON ARMY REGULATIONS

In order to assess the potential need for modification of ARs due to metric conversion, FI undertook a limited survey of Army Regulations. The study team selected a number of ARs which we believe are a representative sample and give some indication of the impacts of metric conversion.

AR 700-1 lays down guidelines and delineates areas of responsibility for implementation of the metrication program within the Army. The background to AR 700-1 is the Metric Conversion Act of 1975 and the DoD is concerned that implementation be as smooth and as cost-effective as possible.

AR 700-1 states that representation on the DA Metric Advisory Group shall be provided by the Deputy Chief of Staff for Research, Development and Acquisition, the Deputy Chief of Staff for Logistics, the Comptroller of the Army, the Deputy Chief of Staff for Operations and Plans, the Surgeon General, the Chief of Engineers and the Commanding General, U. S. Army Training and Doctrine Command. The Secretariat to the DA Metric Advisory Group and the establishment/chairing of a DA Metric Advisory Group is the responsibility of the Commanding General, U. S. Army Materiel Development and Readiness Command. Various metric responsibilities of the same commands are dealt with throughout this paper as they meet with or are affected by other DA actions.

System acquisition is the name given to the Army process for developing and fielding new items of equipment. It is amalgamated into a management model called the "Army Life Cycle Management Model for Army Systems" (LCMM). The LCMM serves as a guide to the acquisition of new systems and shows the main and secondary steps which

contribute to the development and fielding of new or improved materiel. There are four phases in the LMCC:--

(1) Conceptual Phase
(2) Validation Phase
(3) Full Scale Development Phase
(4) Production and Deployment Phase

Each of these steps is a major point in the acquisition cycle and a decision has to be made on each one when it is arrived at. The Defense Systems Acquisition Review Council (DSARC) leaves the decisions to the Deputy Secretary of Defense (DEPSECDEF). On occasions, however, ASARC (Army Systems Acquisition Review Council) is the highest review and the final decision is made immediately. The decision is recommended by an In-Process Review (IPR). It will probably be helpful to outline briefly the composition of the four stages and their part in the system acquisition.

In the Conceptual Phase, the combat development agencies closely examine threat forecasts, technological forecasts, and joint and Army plans to determine operational capabilities, doctrine and specific materiel requirements which will provide Army forces with improved capabilities. Concept formulation studies are carried out and experimental hardware developed and evaluated to establish the technical, military and economic basis for proposed developments and to ensure concept feasibility. Subsequent phases are designed to cope with serious technical and operational issues, including any special logistics problems.

The Validation Phase consists of the steps which are necessary to verify preliminary design and engineering, accomplish necessary planning, analyze tradeoff proposals, deal with those logistics problems which emerged during the Conceptual Phase, prepare the Formal Requirements documents and prepare contracts as required for full-scale development. This is also the stage at which prototypes may be used to clarify cost, environmental impact, human engineering and operational and/or technological factors before entering full-scale development.

During the Full-Scale Development Phase, the system is developed completely. All its support items are engineered, manufactured and tested and the whole is assessed for its acceptability to enter the inventory and be type-classified.

The last phase is the Production and Deployment Phase during which the operational units are trained, equipment is obtained and distributed and logistical support is dealt with. It is at this stage, too, that product improvements are applied to the equipment where necessary.

Usually, the Army satisfies its materiel needs by three methods:-- (1) it buys already-developed equipment which may be domestically or foreign produced; (2) it improves on present design and construction; and, (3) a new materiel development program is initiated. The Army must be cost-conscious and therefore adaptation of the present system is preferred to new purchase. The materiel design must be flexible enough to allow for constant adaptation and modification and the emphasis will be on simplicity, austerity and supportability.

Clearly, system acquisition is an important and complicated process. A well-defined procedure, based on extensive documentation, has been formulated to deal with the matter and it becomes obvious from examination of this procedure that a totally new measurement system will necessitate many changes, at least in the documentation.

As far as the DA is concerned, metrication is a pervasive process which must be catered for in all areas of operation. The effects are felt not only upon army hardware, i.e., supplies and equipment, but on the drawings, specifications and requirement documents which accompany them. Practical training in the use of the new system has to be planned, documented and carried out and throughout the process known as system acquisition, provision for metrication must be made.

This paper is intended to provide guidance on and offer some examples of the need for a metric element in a selection of Army Regulations.

Since system acquisition is based upon or directed by these documents, it is essential that the documents define clearly the steps to be taken to cope with the metric aspect.

AR 71-9: Force Development

Materiel Objectives and Requirements

AR 71-9 states that the Commanding General of the U. S. Army Materiel Command (CG AMC) has responsibility for:--

"(1) f. Participating with the combat developer in the preparation of Letters of Agreement (LOA) to initiate joint investigations of promising programs.

g. Participating with the combat developer in the preparation of Letter Requirements for low-value items.

h. Assisting combat developers in the preparation of Required Operational Capability (ROC) and associated documentation.

i. Preparing, in coordination with the combat developer, Outline Development Plan (ODP) and Development Plans (DP) for both major and non-major systems.

j. Providing required information and briefings to ASARC and DSARC and attendance at ASARC for materiel systems with assigned areas.

m. Assisting combat developers in the preparation of Basis of Issue Plans (BOIP).

The purpose of the Letter of Agreement, according to AR 71-9, "is to ensure agreement between the combat developer on the nature and characteristics of the proposed system and the investigations needed to develop and validate the system concept; to define the associated operational, technical and logistical support concepts; and to promote synchronous interaction between the combat developer and the materiel developer during the conduct of these investigations." When an LOA is approved by the Deputy Chief of Staff for Operations

and Plans, it is passed to U. S. Army Training and Doctrine Command. According to AR 700-1, it is TRADOC which is responsible for "Ensuring that all requirements documents clearly specify operational requirements that may influence the decision on whether new materiel will be designed and configured to the SI." It is, therefore, essential that the LOA include metric references where appropriate and these will be verified by TRADOC. The LOA can then be modified or amplified, if necessary.

Another document which must include a metric dimension is the ROC (Required Operational Capability). According to AR 71-9, a ROC is a HQDA document which states concisely the minimum essential operational, technical, logistical and cost information necessary to initiate full-scale development or procurement of a materiel system. ROCs are appropriate for both combat development and non-combat development systems. The ROC is the direct result of the Letter of Agreement in the case of developmental items. It is submitted to the Deputy Chief of Staff for Operations and Plans when the operational and technical feasibilities and the cost of a system have been determined. AR 71-9 lays down that "all combat development ROC will be coordinated with TRADOC" and "all comments and recommendations from TRADOC must be included."

This again, relates to TRADOC's role as defined in AR 700-1 - ensuring that requirements documents contain a metric aspect. It is, of course, the responsibility of DCSOPS to approve all ROCs after a determination of the impact of their proposed systems on the Army's operational capabilities and the "overall resource impact (force design, personnel requirements, logistics and life cycle costs." In this, DCSOPS will probably be guided by the advice of the representatives he must supply to the DA Metric Advisory Group. Selected ROCs are sent to the United Kingdom, Australia and Canada for comment - this is TRADOC's responsibility and since the three are metric or metric-transitioning countries, TRADOC must ensure that the ROC does not include any metric ambiguities.

Chapter 6 of AR 71-9 deals with yet another document, the Letter Requirement (LR). This is defined as that document which "provides an abbreviated procedure for acquisition of low-value items and will be used in lieu of the ROC when applicable." The Letter Requirement is drawn up by the combat developer and the materiel developer for a proposed materiel system, total RDTE expenditure on which will not exceed $1 million. According to the AR, the Letter Requirement "will constitute the requirement of record for the system and will provide the basis for budget and program control." AR 700-1 states that the Comptroller of the Army will advise DA staff agencies and major field commands on budgeting with a view to metric efforts so the Letter Requirement must state clearly if and where metric effects of the system to be acquired will influence budget decisions.

When study or analysis of a system or experiment is required, a Special Task Force (STF) or Special Study Group (SSG) is convened. Several documents are required for this purpose, amongst them a Letter of Instruction (LOI) which lays down the conditions and objectives of the STF or SSG, a Decision Coordinating Paper (DCP), a Defense Program Memorandum (DPM) and an Army Program Memorandum (APM). A final report is issued by the STF or SSG and is distributed by DCSOPS or TRADOC to appropriate commands and agencies. The report covers areas such as systems summary, systems requirements, discussion of alternatives considered and relationships to other systems. It also defines the personnel and training requirements. TRADOC has, therefore, two direct areas of responsibility - per AR 700-1 - "providing training on the use of the metric system of measurement" and ensuring that the metric dimension is provided for in the final report of the STF or SSG.

Cost and operational effectiveness considerations are another aspect to be considered in the acquisition of a system. While the concept is being developed and formulated, a formal Cost and Operational Effectiveness Analysis (COEA) must be prepared. This will be done by DCSOPS in coordination with CG TRADOC and presented to the STF or SSG director as part of his study authorization. It is for CG

TRADOC to "request reviews of the COEA for the purpose of ensuring proper standardization of scenario and use of adequate methodology or for inclusion of other quality control procedures." "TRADOC will prepare an executive summary of the COEA to accompany the ROC to HQDA for approval." This, again, is a matter for the close attention of CG TRADOC, in line with his metric responsibilities delineated in AR 700-1.

AR 71-2: Force Development

Basis of Issue Plan (BOIP)

There are two types of plan defined by AR 71-2: BOIP I and BOIP II. The first is described in AR 71-2 as "an initial estimate covering the planned placement of a new item of equipment and anticipated personnel changes as indicated by the proposed requirements document.....BOIP I informs all participants in the materiel acquisition process of the planned placement of the new item of equipment and provides HQDA with essential information required for initial planning and programming computations in the Structure and Composition System. BOIP II is a complete plan projecting the organizational placement of a new item of equipment....BOIP II includes planned changes in other equipment and personnel that will be necessary to support the new item of equipment....." It can be seen, therefore, that these two documents are an important part of the Life Cycle System Management Model, since their function is to "predict early in the materiel acquisition cycle for planning purposes, quantitative requirements for a new item of equipment to be included in Tables of Organization and Equipment (TOE), Tables of Distribution and Allowances (TDA), Common Tables of Allowances (CTA). The Basis of Issue Plan serves also to "predict other equipment and personnel changes that may be necessary....to accomodate the new item of equipment" and it "serves as a management tool for HQDA" by "forecasting new equipment densities for procurement programming purposes and to identify resultant personnel changes." The BOIP is a management tool for combat developers for revising TOE and for

other major commands...." The Deputy Chief of Staff for Operations and Plans has Army General Staff responsibility for BOIP. As part of his task, he must furnish "semiannually a list of BOIP items to DARCOM (EARA), USACC, TSG, COE and USASA for which these agencies are responsible so that each may determine if type classification, availability dates and cost projections are still valud." As far as combat developers are concerned, "U. S. Army Communications Command (USACC), U. S. Army Security Agency (USASA) and U. S. Army Health Services Command (HSC) will develop, coordinate and submit BOIP in accordance with parameters and guidance provided by U. S. Army Training and Doctrine Command." It is, then, TRADOC's job to "develop, review, update and coordinate BOIP on equipment proposed to enter the Army supply system..." Given that TRADOC provides guidelines for other combat developers and in view of the Command's role as defined in AR 700-1, provision should be made in the BOIP for (a) metric clause(s). TRADOC plays a very large part in the handling of the BOIP from initiation to completion and this document will need careful study by the Command to comply with its metric responsibility stated in 700-1.

AR 70-47: Research and Development

Engineering for Transportability

The objective of this regulation is to "assign responsibilities and prescribe procedures for the administration and operation of the Army Engineering for Transportability Program." The responsibilities statement of the AR allocates tasks to DCSOPS, DCSRDA and the Commander, Military Traffic Management Command. The first must "receive, coordinate and approve Army materiel requirements documents which require DA approval." DCSOPS will be able to do this in a metric context by his provision of representatives on the DA Metric Group. The Deputy Chief of Staff for Research, Development and Acquisition must "ensure that transportability is considered during each phase of development and that transportability testing is conducted, if required." AR 700-1 gives DCSRDA responsibility

for approval and promulgation of overall Army policy on conversion to the SI and so he will have to ensure that the issue of metric sized components and compatible means of transportation is covered. The task of the CG MTMC (Military Traffic Management Command) must be borne in mind by those preparing and reviewing LOAs, LRs, ROCs, etc., since AR 70-47 states "when considering procurement of commercial materiel systems to meet Army in the field needs [MTMC must] determine whether modification is necessary to meet transportability characteristics, including those necessary for logistics-over-the-shore (LOTS) and airborne operations." TRADOC, for example, is directly implicated in 70-47 i (1) "Combat developers will - Ensure that transportability requirements are adequately stated in the development of military and materiel requirements documents." TRADOC is mentioned directly in i(5) "Designate command and, as appropriate, subordinate command primary and alternate transportability focal points from transportation and engineering in conjunction with the Integrated Logistics Support Program" - in j(1) "Validate essential transportability characteristics to assure that they are in accord with current doctrine," j(2) "Coordinate with AMC and MTMC to assure that transportability documentation, in conjunction with other source data, is adequate to support the preparation of literature for training and operations."

Appendix F of AR 70-47 contains a "Definition of transportability problem item" and states:- "An item of equipment in its proposed shipping configuration which, because of its size, weight, or fragile or hazardous characteristics, may be denied movement, will require special permits or waivers and/or special equipment or handling..." Various criteria for "problem items" follow and instructions for the completion of a transportability report "by any Army activity responsible for design, development, procurement or modification of materiel, or by their contractor, on those items identified as a potential transportability problem..." The report must contain, in part, the "configuration of the item assembled or prepared for transportation, including packaging, if required, to include (1) a sketch or drawing showing plan, side and end views

with dimensions for length, width, and height, and location of center of gravity. (2) Weight. (3) Unusual dimensional characteristics such as projections." Decisions will have to be made on dual or single (metric) measurements in reports to cover these items and, as previously stated, this concerns all Army organizations involved in design, development, etc. It will probably fall to TRADOC to ensure that (1) as well as (2) and (3) are complied with as far as documentation is concerned.

AR 10-1: Organization and Functions

Functions of the DoD and its Major Components

The introduction to this AR states that: "This regulation contains information and guidance which will be used to formulate policy on matters concerning the functions of the Department of Defense and its major components." In Section V, "Functions of the Military Departments and the Military Services," the AR emphasizes the preparation of forces and establishment of reserves of equipment and the maintenance in readiness of mobile reserve forces which are trained and equipped adequately. It is also stated that departments "assist each other in the accomplishment of their respective functions, including the provision of personnel, intelligence, training facilities, equipment, supplies and services." Clearly, therefore, given the permeation of metrication within the Army, all those commands referred to in AR 700-1 will need to cooperate as closely as possible to carry out their metric tasks and to comply with the requirements of AR 10-1. This applies particularly to the Comptroller in providing budget support for training, to DARCOM in providing assistance and training in metrication, to TRADOC in the area of documentation, tools and equipment and to those referred to in AR 700-1(g).

AR 70-27: Research and Development

Outline Development/Plan/Development Plan/Program Memorandum/Defense Program Memorandum/Decision Coordinating Paper

This AR is concerned with documentation. Under "Purpose and Scope" it is stated that the regulation "prescribes policy, procedures and content for Outline Development Plan (ODP), Development Plan (DP), and Army Program Memorandum (APM) and defines responsibilities for processing OSD Decision Coordination Papers (DCP) and OSD-directed Defense Program Memorandums (DPM)." It also "describes the interrelationships among Outline Development Plans, Development Plans, Decision Coordinating Papers, Defense Program Memorandums, Army Program Memorandums and the Materiel Acquisition Decision Process (MADP) decision reviews by DSARC, ASARC and formal IPR." This AR relates directly to AR 71-9 mentioned at the beginning of this annex. DCSRDA is responsible for advising the Assistant Secretary of the Army for R&D (ASA(R&D)) "when it becomes clear that any of the approved threshholds in an APM/DPM/DCP may be breached." It is he, in fact, who has complete Army Staff responsibility for ODP, DP, APM, DPM, DCP and for coordinating all ASARC/DSARC reviews. According to the AR, "he will ensure that draft APM, DP and DCP, including system costs, quantities and schedules, are compatible with resources available to the Department of the Army. Since DCSRDA must supervise the implementation of SI policies, these documents must be explicit about the metric aspect. The ODP, for example, "contains the materiel system concept agreed upon by the materiel developer and combat developer. It records program decisions.... The ODP will be prepared....in conjunction with the Letter of Agreement. It may be simplified, or portions may be omitted if not appropriate, depending on the complexity and stage of the specific program." The ODP contains the following sections: (1) the System Concept Summary, containing the LOA, (2) System Concept Requirements and Analyses (which will treat the Concept Formulation Package (CFP) -

"a discussion of the alternatives considered and an initial assessment of environmental impact and logistic support for each alternatives considered and an initial assessment of environmental impact and logistic support for each alternative") (3) Plans for System Concept Development which will attempt to relate development to supplies availability. This is a point at which the accessibility of metric supplies and components should be dealt with. Another component of the ODP is the Technical Development Plan, the essence of which is the specification of "product improvement of existing components, energy efficiency....transportability and reliability, availability and maintainability (RAM) criteria, logistic considerations, producibility engineering and planning (PEP)." There are obvious areas of metric consideration in this section of the ODP. The Management Plan, which follows the Technical Development Plan, includes "schedule and performance measurement, risk analysis, configuration management, systems engineering management, product assurance, standardization and technical documentation" - the latter implying TRADOC's role in SI documenting and cooperation with DARCOM in accordance with AR 700-1 2(f) Page 1-2. Another ODP section with metric implications is 5(c) - Plan for Personnel and Training Requirements. "This plan will include identification of skills, individual and crew-training requirements, training devices, train= ing facilities..." Again, this is a TRADOC area of operations and the plan should refer to metrication where appropriate. The last section of the ODP is the Plan for Logistic Support, part of which states "....anticipated critical supportability issues, recommended reliability, availability and maintainability objectives." Metric issues should be considered here.

The Development Plan is another document "which records program decisions, contains the approved materiel requirement, and provides appropriate analysis of technical options and life cycle plans for development, testing, production, training support and logistic support of materiel items." Like the ODP, the DP has several sections - System Summary, System Requirements and Analyses, Plans for System Development, Technical Development Plan, Management Plan,

Financial Plan, Facilities and Resources Plan and a Producibility Plan. The latter "will provide the basis for assurance that tooling requirements for production have been established by consideration of the most economical production rate and manufacturing processes." Tooling is a major metric impact area and this is a subject of particular interest to TRADOC (700-1 f(5)). Section V of the DP is a Plan for Personnel and Training Requirements and will include "identification of new skills, new equipment training requirements, individual and crew training requirements, training devices, training facilities and associated schedules." This will probably call for close cooperation between DARCOM and TRADOC from the standpoints of DARCOM's "maintaining an integrated, cost-effective DoD program for conversion to the SI" and TRADOC's "providing training on the use of the metric system of measurement," and "ensuring that all requirement documents clearly specify operational requirements...." in line with AR 700-1. Section VI of the DP is the Plan for Logistic Support. This section will include "a plan for logistic support, including milestones for verifying logistics support at each key decision point." AR 70-27 also states that the section should contain "identification of special logistic needs, updated estimates of life cycle support costs" and a "plan for identification of logistic support resource requirements such as personnel skills, training, support equipment, spares and repair parts, technical data and facilities." All these involve the departments of the DCSLOG, DCSRDA and TRADOC and the metric implications are obvious.

The preparation of an APM (Army Program Memorandum) is the responsibility of the Department for Research, Development and Acquisition. It is described in AR 70-27 as "an Army acquisition recording document that presents rationale for starting, continuing, reorienting or stopping a selected program at each critical milestone in the materiel acquisition system." Where it is felt that metrication might impinge on any of these, it is probable that mention must be made at an appropriate point.

The DPM (Defense Program Memorandum) is similar to the APM in content - "an acquisition recording document that presents rationale for starting, continuing, reorienting or stopping a selected program at each critical milestone in the acquisition cycle." The purpose of this OSD-directed document is to establish the objectives and evaluate those factors which affect them. "It is the official document which records the decision(s) of OSD staff principals." The preparation of a DPM is the responsibility of an STF, SSG or the relevant materiel developer. DPMs are reviewed by DCSRDA in coordination with DCSOPS and DCSLOG to see if review by the ASARC is necessary. If it is felt that such review is required, the draft APM will be prepared by a Special Task Force or Special Study Group. If review by the ASARC is not felt to be necessary, the DPM will be prepared by the materiel developer. In either case, the cooperation of the three previously mentioned commands is required and each must bring his area of metric responsibility to bear on the document's preparation.

The last document mentioned in AR 70-27 is the DCP (Decision Coordinating Paper). It is "an OSD acquisition decision recording document which presents rationale for starting, continuing, reorienting or stopping a selected program at each critical milestone in the acquisition cycle. It identifes the objectives, conditions and issues pertinent to each decision and assesses all important factors which influence the decision(s) of the Secretary of Defense." Responsibility for DCP lies with DCSRDA whose responsibility for "approval and promulgation of overall Army policy on conversion to the SI" will doubtless influence the content of the document.

AR 70-4: Research and Development

Standardization among Armies of United States, United Kingdom, Canada, Australia

This Army regulation is concerned with the tasks and duties arising from standardization procedures among the above-mentioned armies (including New Zealand). The objective of the AR is to "enable the military forces of the United States and its allies to operate

together in the most effective and efficient manner and to make the most efficient and economical use of research, development, test and production resources." Standards/standardization fall to DARCOM according to AR 700-1 - "arranging for DARCOM or other major field commands to provide army representatives on DoD, Federal Government and/or Industry task forces, boards or committees on metrication projects or operations to develop policy, standards, specifications or regulations related to metric conversion." This is an urgent and important task, in view of the fact that the UK and Canada are metric-transitioning countries - Australia is virtually completely metric in the consumer area - militarily, the transition will last for an indefinite period. The Chief of R&D must provide the U. S. Army Member of the Washington Standardization Program within the U. S. Army. It is clear that DARCOM, too, will have to participate in this exercise, following on its responsibility (mentioned above) referred to in AR 700-1.

Chapter 3 of AR 70-4 is entitled "Non-materiel standardization." On this question, some documents which will doubtless have to contain a metric element are listed. There is, for example, the QSTAG (Quadripartite Standardization Agreement) drawn up by the Quadripartite Agreements Committee. A DA agency which proposes a non-materiel subject for standardization must forward a draft QSTAG (70 copies) to ACSFOR for "coordination and submittal to the QAC for appropriate actions." The DARCOM standards representative(s) will probably contribute to such a document, since it is he/they who will evaluate "new or revised DoD national and/or international standards using the SI...."

Paragraph 3-2 deals with the "Quadripartite Armies' Operational Concepts" which are a key means of achieving standardization. Their purpose is to guide the combat developments and research and development efforts of the armies involved in order to attain maximum interoperability...." These concepts are developed for the ABCA armies by the Quadripartite Working Group on Combat Developments. They are drafted by the armies according to previous agreement and are

circulated for national approval. It is probable that DARCOM will be involved here, subject to its standardization instructions in AR 700-1.

Chapter 4 of AR 70-4 deals with Materiel Standardization. Paragraph 4-1, General Principles, states: "Standardization may be achieved through coordination during the development of new materiel so that such equipment is made compatible and/or acceptable for common use in the four armies. Standardization of technical procedures facilitates standardization of materiel items by reducing problems of production, maintenance and spare parts." The steps for accomplishing the phases of the development cycle are outlined in Paragraph 4-4 and include Statements of Equipment Policy, Statements of Requirement, Statements of Plan of Engineering Design, Engineering Testing (the last two, the responsibility of DCSRDA) Service Tests, Type Classification and Procurement Production and Maintenance of Agreed Degree of Standardization. It is likely that the metric consideration will enter into some or all of these phases and a note to that effect may have to be added to the completion instructions for the documentation of each phase.

Chapter 5 of AR 70-4 is entitled "Loan of Equipment." Under the heading of "Authority," it is stated, "Loans of equipment are authorized under this program for test, evaluation or other purposes facilitating research and development." Paragraph 5-3(a) describes the basis for loan. Sub-section b(2) states, "These actions (i.e. coordination, invitation, forwarding of test reports) assume particular importance when equipment requested is expensive or complicated, when maintenance and repair parts support will be difficult or expensive...." The plans of engineering and the test reports may very well have to contain metric provision if, indeed, metric or customary spares are unavailable or difficult to obtain.

AR 70-2: Research and Development

Materiel Status Recording

AR 70-2 is a regulation which "assigns responsibilities and prescribes procedures for the uniform recording of decision and actions pertaining to research and development, test and evaluation, type classification, supportability and associated activities related to the acquisition and management of items of materiel, including off-the-shelf equipment for the U. S. Army." The Chief of Research, Development and Acquisition will have overall Army General Staff responsibility for supervising the recording of materiel status decisions and actions and in this area, the new measurement system will probably require note. The Commanding General, U. S. Army Materiel Command must, according to AR 70-2, "Establish and maintain appropriate records that will give a chronological, comprehensive and official history of each research and development project and item of equipment. When a component becomes metric dimensioned, this will have to be noted in the record as will the effect of metrication on any R&D project.

AR 70-17: Research, Development and Acquisition

System/Program/Project/Product Management

The objectives of AR 70-17 are to "emphasize the management of and allocation of resources (personnel, funds and facilities) to those programs that are most critical to the nation's defense posture or most costly to the Department of the Army" and to "strengthen management effectiveness by establishing procedures for the use of small, centralized organizations which intensively manage the development, production, Integrated Logistic Support (ILS), deployment and materiel readiness of single items, systems, or a limited number of related items or systems, in the most efficient manner and within approved schedules and the resources available." Responsibility for carrying out the instructions of this AR lie mainly with DCSRDA. He must nominate DA system coordinators to act as DA points of contact. In as far as metrication is an issue in the "development, production

and Integrated Logistic Support" of a system, DCSRDA must carry out his supervisory function in AR 70-17 in the light of his AR 700-1 mandate to approve and promulgate overall Army policy on conversion to SI. He must review the submission of proposed Program/Project Manager charters for metric implications or their insertion where appropriate. AR 70-17 refers to the ODP and DP (AR 70-27). These two documents have already been discussed and the importance of their review with the advent of metrication must be emphasized.

The documents ROC, LOA and ODP are referred to in AR 70-17, as they apply to a Program/Project Manager. One of the documents is his charter and where metrication is involved, it should be emphasized again that these documents should clearly state its impingement.

Paragraph 18 of the instructions for the Program/Project Manager deals with his responsibility for reviewing Military Specifications/ Standards requirements. This will probably be a follow-on of DARCOM's review of standards and specifications which will require metric adjustment.

ANNEX L

PROJECT MANAGER'S CHECKLIST

ANNEX L

PROJECT MANAGER'S CHECKLIST

Introduction

As a part of the most logical least cost strategy of metric conversion, this study proposes that the Army emphasize the provision of AR 700-1 which prescribes mandatory consideration of the metric system for all new designs. Rationale supporting this emphasis is provided throughout the report.

While this report also recommends proceeding on all fronts at once, there has to be a beginning point. There has to be some way of establishing criteria, of determining where the greatest leverage can be applied, of recognizing the points of greatest sensitivity. The criteria of AR 70-17 establishing those systems which are important enough to require project management can act as a screening device to determine where priorities lie within the development of new designs. Those items important enough for project management should receive more intensive scrutiny. It follows then, that the DA Metric Office should work intensively with project managers to achieve metric conversion. The purpose of this annex is to help provide a foundation for that cooperation and suggest actions that project managers might take to achieve maximum least cost conversion.

Background

Neither the Army, nor even DoD, can influence U. S. industry at large. The problem the Army will face at any given moment is to establish the degree to which industry has converted and then reflect that degree of metric conversion in requirements or procurement documents. Again, this concept is in complete consonance with AR 700-1. To do otherwise will necessarily incur unnecessary costs.

There are two possible exceptions. One is that DoD; hence DA, will probably be willing to bear a share of unavoidable costs connected with conversion. Points for particular emphasis here are the rapid conversion of specifications and standards as well as adoption of standard fasteners.

The other exception lies in the program for rationalization, standardization, and interoperability. To achieve these goals, the Army may be willing to incur additional costs. At the present time, it appears that the importance attached to these objectives is so great that necessary metric conversion will be forced almost without respect to costs. Recognition of this motive and prior planning can at least help reduce the penalty.

Further, it should be noted that there is a general trend toward metric conversion in U. S. industry where exports or other international interests are present. To delay conversion in these sectors may induce cost penalties. This point relates back to keeping in touch with industry.

Finally, life cycle costs must be considered. Initially higher costs for conversion may be offset by longer life and longer maintainability. Cost considerations are developed more fully in the main body of the report.

Plan of Action

To reduce these general considerations to a plan of action, the following project manager's checklist is provided. With the detailed management models provided by the life cycle model and the integrated logistics system, no attempt has been made to develop yet one more system of management. The effort here is to relate to those models and specify a possible framework for adoption of metric design.

Checklist

1. Consider metric design in an explicit manner at each decision point of the management models.

2. Prior to release of requirements documents, make a go-no-go decision on metric content. It would appear that new designs are most sensitive to metric conversion up to the point of release of requirements documents. Afterwards, change orders or changes in requirements will cause an unnecessary increase in cost. Here are some ways the project manager would determine maximum no cost metric content or justify funds for achieving metric conversion goals:

   a. What is the current status of specifications and standards? Will the expenditure of funds result in a more rapid conversion of specifications, standards, or fasteners thereby lowering overall conversion costs? (Note: The more rapidly complete conversion can be accomplished, the less the overall expense. See main body of the report.)

   b. Are RSI interests great enough to justify some conversion costs?

   c. What is the current status of industry?

      (1) The project manager could consult with the DA Metric Office for current information and status of the Army's metric conversion plans.

      (2) The project manager can identify those sector representatives who would potentially have the most current knowledge concerning industry conversion. Then in connection with the DAMO, he could contact these representatives for specific no cost statements concerning maximum metric content. The greatest benefit would be gained by bringing these representatives together for a face-to-face meeting and interchange of opinions.

      (3) As an alternative which would perhaps be more attractive, more timely, less costly, and more efficient, the project manager can simply require industry to

state the degree of metric conversion it is prepared to undertake in responding to an RFP or other similar document. This could be made a point of evaluation of the proposal. In addition, if funds specifically earmarked for conversion are available, the project manager could specify incremental increases. It is suggested that this latter idea be reserved only for high priority items.

3. Conduct a survey of potential suppliers prior to release of requirements documents both for degree and manner of expressing conversion requirements. Ensure interchange of conversion plans with potential suppliers.

4. What are life cycle costs of differing degrees of conversion? Again, knowledge and opinion of sector representatives will be required.

5. Have potenital benefits been identified?

6. Is industry production capability sufficient to provide the quality and quantity needed?

7. Are metric requirements to include provision of special tool sets, test equipment, and color coding of hybrid parts reflected throughout the system? Have other system considerations such as training and supporting stocks of parts been fully considered.

8. Consider dual dimensions, soft conversion.

9. Consider possible impact on delivery schedules.

10. Has top management stressed conversion?

ANNEX M

RECOMMENDED CHANGES TO AR 700-1

ANNEX M

RECOMMENDED CHANGES TO AR 700-1

Chapter 7 developed a normative Army metrication organization to accomplish the Army metrication mission and metrication objectives (given in Chapter 2), and to support the recommended metrication strategy developed in Chapter 5. This normative organization was compared, in Section 6 of Chapter 7, with the current Army metrication organization as published in AR 700-1. A number of structural discrepancies were identified in this comparison. Proposed changes to AR 700-1, to deal with these discrepancies, are given below. A revised AR 700-1, incorporating the proposed changes, is contained in Appendix 1.

Proposed Changes to AR 700-1

AR 700-1

Page	Paragraph	Recommended Change
1-2	1-5a(3)	Delete
1-2	1-5e(1)	Delete and substitute therefor: "(1) Establishing a central Department of the Army Metric Office, designating a Department of the Army Metric Coordinator, and providing other appropriate personnel to staff the DA Metric Office."
1-2	1-5e(2)	Delete entirely
1-2	1-5e(3)	Renumber 1-5e(2)
1-2	1-5e(4)	Renumber 1-5e(3)
1-2	1-5e(5)	Renumber 1-5e(4) and add: "...Group with responsibilities for developing and recommending to HQDA, Army policy on conversion to the SI. This is to be done in coordination with the Chief of Engineers; and the Commanding Generals of the U. S. Army Training and Doctrine Command, U. S. Army Forces Command, U. S. Army Communications Command, and other major field commands."

Page	Paragraph	Recommended Change
1-2	1-5f(3)	Second word: delete "their" and substitute "TRADOC" therefor.
1-3	1-5h	Add new paragraph:

"h. The DA Metric Coordinator is responsible to the Chairperson, DA Metric Advisory Group. The DA Metric Coordinator, heading the DA Metric Office, has responsibilities for:

(1) Developing, establishing, and maintaining, an Army plan/ program for conversion to the SI.

(2) Reviewing and evaluating the effectiveness of Army-wide metric conversion efforts, identifying problems, and initiating and/or recommending corrective actions.

(3) Providing for coordination with other military departments, the Defense Logistics Agency, and other Defense Agencies to ensure intraservice/interservice compatibility and maintaining an integrated, cost effective DOD program for conversion to the SI.

(4) Providing the Army member to the DOD Metrication Steering Group.

(5) Providing the Secretariat to the DA Metric Advisory Group.

(6) Arranging for DARCOM or other major field commands to provide Army representatives on DOD, Federal Government and/or Industry task forces, boards, or committees on metrication projects or operations to develop policy, standards, specifications, or regulations related to metric conversion.

(7) Coordinating metric activities and providing advice on metric conversion within the Army.

(8) Providing technical information and assistance in support of Army-wide metric conversion activities."

Page	Paragraph	Recommended Change
A-1	A-1b.	Renumber A-1c and insert new paragraph: "b. Develop and recommend to HQDA (Deputy Chief of Staff for Research, Development, and Acquisition) Army policy on conversion to the SI."
A-1	A-2a(1)	Delete; renumber paragraphs (2) through (8).
A-1	A-2a(9)	Change to read: "(8) The DA Metric Coordinator (provides Secretariat)."

APPENDIX 1 to ANNEX M

DRAFT REVISED AR 700-1

ARMY REGULATION
No. 700–1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC

LOGISTICS

Army Conversion to the Metric System of Measurement (International System of Units (SI))

This regulation establishes policies and responsibilities for Department of the Army conversion to the Metric System of Measurement (International System of Units (SI)). Local limited supplementation is permitted, but is not required. If supplements are issued, Army staff agencies and major Army commands will furnish one copy of each within 60 days from date of publication to HQDA (DAMA-PPM-M) WASH DC 20310 and DARCOM (DRCQA-PC) 5001 Eisenhower Avenue, Alexandria, Virginia 22333; other commands will furnish one copy of each to the next higher headquarters.

CHAPTER 1

GENERAL

1–1. Background. *a.* The Metric Conversion Act of 1975, 15 U.S.C. 205 a–k (PL 94–168), established a national policy of coordinating the increasing use of the metric system of measurement (International System of Units (SI)) in the United States.

b. Department of Defense Directive 4120.18, 10 December 1976, Use of the Metric System of Measurement, established policies for the use of the International System of Units (SI) within the Department of Defense (DOD), and established the following objectives:

(1) Many Defense-related industries have converted or are planning conversion from the US customary inch-pound measurement system to the SI. The Department of Defense must be able to accept such conversion with minimum cost and disruption of operations.

(2) Use of the SI will help foster standardization with our allies and thus promote interchangeability and interoperability, facilitate joint military production programs, and simplify supply operations.

(3) Consideration of metric usage is especially appropriate in the design of new Department of Defense materiel where metric products are expected to be in common use at the time of production release.

(4) Generally, it is recognized that industry will take the lead in the changeover, and that DOD components will keep pace by adopting commercially available metric items wherever economically and technically practicable.

1–2. Purpose. This regulation—

a. Prescribes policies for Army conversion to the SI.

b. Assigns responsibilities for direction, management, and operation of the Army conversion to the SI.

c. Implements Public Law 94–168, 23 December 1975, The Metric Conversion Act of 1975, and Department of Defense Directive 4120.18, 10 December 1976, Use of the Metric System of Measurement.

1–3. Scope. This regulation is applicable to all Army units, organizations, installations, commands, and activities, including the National Guard and US Army Reserve.

1–4. Explanation of terms. In addition to the definitions in AR 310–25, the following explanation of terms will apply to this regulation:

a. Customary System of Measurement. The inch-pound system formerly and currently used in the United States (foot, inch, pound, horsepower, B.T.U., degree Fahrenheit, etc.).

b. Metric System of Measurement. The International System of Units (commonly abbreviated as SI) described in American Society for Testing and Materials (ASTM) E380 Standard for Metric Practice, (also numbered ANSI (American National Standards Institute) Z210.1) and IEEE (Institute of Electrical and Electronics Engineers, Standard 268), of the issue listed in the DOD Index of Specifications and Standards.

c. Metrication. The act of increasing use of the metric system of measurement.

d. Hard Conversion. The process of changing customary measurement units to non-equivalent metric units which necessitates physical configuration changes outside those permitted by established measurement tolerances. Although this term is in general use, it is technically incorrect when applied to specific items because no "conversion" takes place; rather, a new metric item (requiring a new part identification) is designed/created to replace the customary item.

e. Hybrid Metric. Configured in both metric and customary units of measurement.

f. Soft Conversion. The process of changing customary units of measurement to equivalent metric units within acceptable measurement tolerances without changing the physical configuration.

1–5. Responsibilities. *a.* The Deputy Chief of Staff for Research, Development, and Acquisition is responsible for—

(1) Approval and promulgation of overall Army policy on conversion to the SI.

(2) General staff supervision of the implementation of such policies by the major field com-

mands (In coordination with the Deputy Chief of Staff for Logistics and the Comptroller of the Army).

b. The Deputy Chief of Staff for Logistics is responsible for--

(1) Approval and promulgation of the logistics portion of Army policy on conversion to the SI (In coordination with the Deputy Chief of Staff for Research, Development and Acquisition).

(2) Providing principal and alternate members to the DA Metric Advisory Group.

c. The Comptroller of the Army is responsible for--

(1) Providing policy and guidance to DA Staff agencies and major field commands on programming and budgeting for the resources required to support the Army metric conversion effort.

(2) Providing principal and alternate members to the DA Metric Advisory Group.

d. The Deputy Chief of Staff for Operations and Plans; The Surgeon General; and the Chief of Engineers are responsible for providing principal and alternate members to the DA Metric Advisory Group.

e. The Commanding General, US Army Materiel Development and Readiness Command is responsible for--

(1) Establishing a central Department of the Army Metric Office, designating a Department of the Army Metric Coordinator, and providing other appropriate personnel to staff the DA Metric Office.

(2) Evaluating new or revised DOD, national and/or international standards using the SI for Army adoption and recommending appropriate action.

(3) Managing the program for conversion of military specifications and standards, for which the Army is the Assignee and/or Preparing Activity, to the SI (AR 700-47).

(4) Establishing and chairing a Department of the Army Metric Advisory Group with responsibilities for developing and recommending to HQDA, Army policy on conversion to the SI. This is to be done in coordination with the Chief of Engineers; and the Commanding Generals of the U. S. Army Training and Doctrine Command, U. S. Army Forces Command, U. S. Army Communications Command, and other major field commands.

f. The Commanding General, US Army Training and Doctrine Command (CG TRADOC) is responsible for--

(1) Providing training on the use of the metric system of measurement.

(2) Ensuring that all requirement documents clearly specify operational requirements that may influence the decision on whether new materiel will be designed and configured to the SI.

(3) Converting TRADOC materiel and activities to the metric system of measurement in accordance with the policies expressed herein and in general compliance with schedules established by the Army metric conversion plan.

(4) Providing, upon request from the Central DA Metric Office, management indicator data that is required for overall analysis of Army metric conversion efforts.

(5) Ensuring that required metric tool and/or test equipment is available in the prior to issuing metric materiel to troop

(6) Providing principal and alternate members to the DA Metric Advisory Group.

g. Theater Army Commands; The Commanding General, US Army Materiel Development and Readiness Command; the Chief of Engineers; the Commanding General, US Army Communications Command; US Army Forces Command; Surgeon General; Chief of Army Reserves and National Guard as applicable to the assigned materiel mission are responsible for--

(1) Converting their materiel and activities to the metric system of measurement in accordance with the policies expressed herein and in general compliance with schedules established by the Army metric conversion plan.

(2) Providing, upon request from the Central DA Metric Office, management indicator data that is required for overall analysis of Army metric conversion efforts.

(3) Providing, training, as required, on the use of the metric system to their management, scientific, technical trades, and administrative personnel who will not be trained by the TRADOC schools.

(4) Ensuring that required metric tools and/or test equipment is available in the field prior to issuing metric materiel to troop units.

h. The DA Metric Coordinator is responsible to the Chairperson, DA Metric Advisory Group. The DA Metric Coordinator, heading the DA Metric Office, has responsibilities for:

(1) Developing, establishing, and maintaining, an Army plan/ program for conversion to the SI.

(2) Reviewing and evaluating the effectiveness of Army-wide metric conversion efforts, identifying problems, and initiating and/or recommending corrective actions.

(3) Providing for coordination with other military departments, the Defense Logistics Agency, and other Defense Agencies to ensure intraservice/interservice compatibility and maintaining an integrated, cost effective DOD program for conversion to the SI.

(4) Providing the Army member to the DOD Metrication Steering Group.

(5) Providing the Secretariat to the DA Metric Advisory Group.

(6) Arranging for DARCOM or other major field commands to provide Army representatives on DOD, Federal Government and/or Industry task forces, boards, or committees on metrication projects or operations to develop policy, standards, specifications, or regulations related to metric con-

(7) Coordinating metric activities providing advice on metric conversion within the Army.

(8) Providing technical information and assistance in support of Army-wide metric conversion activities.

CHAPTER 2

POLICY

2–1. General. Policies set forth herein were established by Department of Defense Directive 1120.18, 10 December 1976, Use of the Metric System of Measurement, for uniform implementation by the Military Departments and DOD Agencies.

a. The Department of the Army will consider the use of the metric system in all of its activities consistent with operational, economical, technical, and safety requirements.

b. The Department of the Army will let industry take the lead in the conversion, however, the Army plan and schedule for conversion will be closely coordinated with industry to ensure that a knowledgeable lead is taken and costs to the Department of Army are minimized.

c. When it is determined that use of the metric system in new designs is not in the best interest of the Department of the Army, based on operational, economic, technical or safety considerations, justification for retaining customary units will be provided.

d. In general, the metric system will be adopted for the following:

(1) Where there is a specific military need, such as for materiel to be used jointly with NATO and other allied nations.

(2) Areas where industry has made significant progress in metric conversion, and production facilities are available.

(3) Areas where defense-industry preparedness or defense production readiness may be enhanced.

(4) Other areas which offer an economic, operational, or other advantage, or when no disadvantage is incurred.

e. In preparing for Army and/or Defense Systems Acquisition Review Council (ASARC and/or DSARC) reviews, Army proponents will ensure that the ASARC/DSARC and associated Decision Coordinating Papers address the use of metric units of measurement or provide reasons for their nonuse.

2–2. Design. *a.* Consideration of the use of the metric system is mandatory for all new designs.

b. During the metric transition phase, hybrid metric and US customary designs will be necessary and acceptable. Materiel components, parts, subassemblies, and semifabricated materials which are of commercial design will be specified in metric units only when economically available and technically adequate or when it is otherwise specifically determined to be in the best interest of the Department of Army. Bulk materials will be specified and accepted in metric units when it is expedient or economic to do so.

c. Where metric and customary US items will be used together, physical and operational interfaces between the items will be designed to ensure that interchangeability and interoperability will not be adversely affected.

2–3. Acquisition. When purchasing new equipment, Army activities are encouraged to specify features which will allow direct measurement in terms of SI units or both SI and US customary units. Use of conversion kits is also encouraged.

2–4. Existing designs. Existing designs dimensioned in US customary units will be converted to metric units only if determined to be necessary or advantageous. Unnecessary retrofit of existing systems with new metric components will be avoided where both the new metric and existing units are interchangeable and interoperable. Normally, the system of measurement in which an item is originally designed will be retained for the life of the item.

2–5. Technical documents. Technical reports, studies, and position papers (except those pertaining to items dimensioned in US customary units) will include metric units of measurement in addition to (in parenthesis) or in lieu of US customary units. With respect to existing contracts, this requirement applies only if such documentation can be obtained without an increase in contract costs.

2–6. Programing and budgeting. Programing and budgeting actions will include resources required to support the Army effort in converting to the use of metric units. Use of the metric system will be identified and planned so that costs can be included in the budget cycle on an orderly basis.

2–7. Specifications and standards. *a.* Representatives of the Department of Army will partici-

pate in the development of DOD, national, and international standards using the metric system, to the extent indicated by Army interest. Use of the International System of Units (SI), in lieu of other metric systems currently in use, will be advocated by Army representatives when establishing agreements and international standards for military and commercial equipment. NATO and other international metric standards will be used to the maximum practical extent. However, if a US Standard is established with greater definition and restriction than a prevailing international standard, the US Standard will apply.

b. Emphasis will be placed on keeping pace with the conversion or development of specifications, standards, and other general purpose technical data. When the item in question is a military item without a commercial counterpart, the preparing activity will assume a leadership role in development of the applicable metric document as the need arises.

2–8. Training. Training in metric practices and usage will be provided, as required, to those personnel whose duties require such knowledge.

2–9. Dual dimensioning. Use of dual dimensions (i.e., both metric and US customary dimensions) on drawings will be avoided unless it is determined in specific instances that such usage will be beneficial. However, the use of tables on the document to translate dimensions from one system of measurement to the other is acceptable.

APPENDIX

THE DA METRIC ADVISORY GROUP

A-1. Purposes of the Metric Advisory Group

a. Periodically review and assess Army policies, procedures, and plans for conversion to the SI.

b. Develop and recommend to HQDA (Deputy Chief of Staff for Research, Development, and Acquisition) Army policy on conversion to the SI.

c. Define specific goals and establish direction in order to promote and attain the Department of the Army's overall metric conversion objectives.

A-2. Membership.

a. Membership in the DA Metric Advisory Group will consist of a principal and an alternate from each of the following DA Staff elements and major field commands:

(1) Deputy Chief of Staff for Logistics
(2) Deputy Chief of Staff for Operations and Plans
(3) The Comptroller of the Army
(4) The Surgeon General
(5) Chief of Engineers
(6) US Army Materiel Development and Readiness Command (Chairperson)
(7) US Army Training and Doctrine Command
(8) The DA Metric Coordinator (provides Secretariat)

b. When selecting members of the Advisory Group--

(1) A reasonable degree of permanency will be considered in view of the long-term effects of metric conversion.

(2) The names, locations, and telephone numbers of principal and alternate members will be furnished to the Chairperson of the group and any changes will be reported promptly.

A-3. Other Participation. Attendance or participation in the activities of the Advisory Group by Army commands, agencies, and activities; other military services; DOD and nonmilitary Government agencies; educational institutions; industry; and private consultants will be as required. Attendance and participation will require prior approval of the Chairperson, Metric Advisory Group.

A-4. Meetings. The Metric Advisory Group will be convened at the discretion of the Chairperson.