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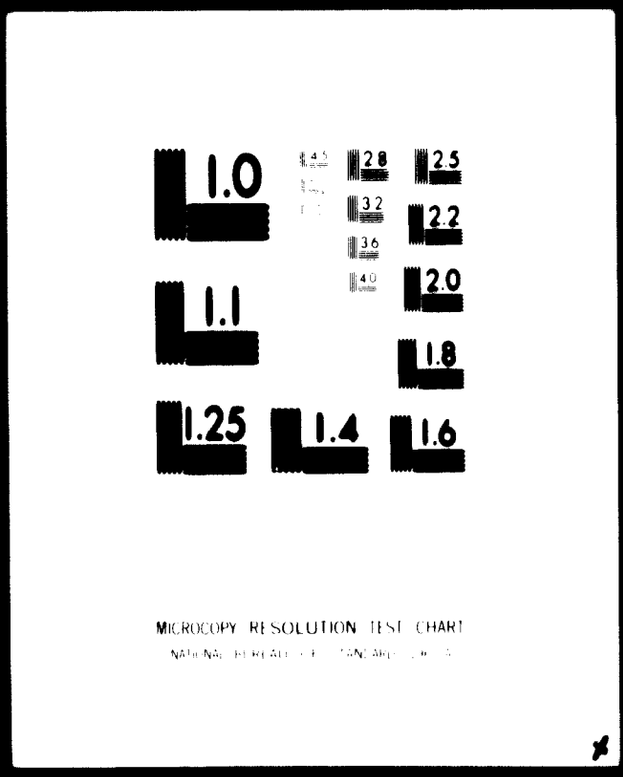

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REPORT
TO
THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
ON
ASSESSMENT OF STEELS DEMAND IN IRAN
FOR
THE MINISTRY OF ECONOMY, IMPERIAL GOVERNMENT OF IRAN

VOLUME I

DECEMBER 1970

M. N. DASTUR & COMPANY PRIVATE LTD. CALCUTTA
DASTUR ENGINEERING INTERNATIONAL GmbH, DUSSELDORF
Consulting Engineers

02093
(1 of 4)

REPORT

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M. N. DASTUR & CO PRIVATE LTD.
CONSULTING ENGINEERS
P-17, MISSION ROW EXTENSION
CALCUTTA-13

Phone: 23-7272
Gram: DASTURENG

30th December 1970
5135-126A

Chief
Technical Procurement and Contracting Office
United Nations Industrial Development Organisation
A 1010 Vienna
Austria.

REPORT ON ASSESSMENT OF STEELS DEMAND IN IRAN

Dear Sir,

We have pleasure in submitting our report on assessment of the demand for tonnage as well as alloy steels in Iran, in compliance with provisions of Contract No.29/69 of 25th June 1969.

The report, presented in four volumes, makes an assessment of the future steel requirements of Iran in 1972, 1977 and 1982, corresponding to the terminal years of the Fourth, Fifth and Sixth Plans, respectively. Volume I contains the conclusions and the classification of steels adopted in this study. Volume II reviews present steel consumption in Iran, discusses the techniques available for forecasting demand, and selects the 'end-use method' combined with intensive field survey as the most appropriate. In Volume III, the demand estimates are analysed and their validity checked by independent demand projections made by other techniques. The possibilities of steel exports and the effect of substitution by other materials are examined and the shortfalls for various categories of steel are discussed in Volume IV together with profiles of some parallel, feeder and steel consuming industries which need to be developed.

The report presents, in text and appendices, comprehensive statistical data, details of assumptions made and of the methods by which micro- and macro-level projections have been derived, in order that the study can serve as basic reference material for keeping track of the development of steel and related industries, and for making suitable adjustment when structural and technological changes arise.

A draft report was submitted in May 1970 and discussed in Teheran in October 1970. Comments made during these meetings have been kept in mind in finalising this report.

Of the various statistical techniques for forecasting steel demand, the end-use method has a high degree of validity for a growing economy like Iran, since it takes into account foreseeable changes, both structural and technological. Basically, the end-use method involves the precise identification of the end-uses of steel in various sectors of the economy and the forecasting of output levels of steel user industries/sectors; the determination of norms of steel consumption for each activity; and the application of these norms to the output levels to arrive at the overall steel requirements.

The study was primarily based on a field survey covering most of the existing large manufacturing and consuming industries in Iran as well as major steel importers.

In making forecasts of development levels of various industries and economic sectors, certain growth rates of national income, industrial production, population etc have been assumed, taking into consideration the current structure and growth potentialities of Iran's economy in the context of the national plans. It must be emphasised that the validity of the forecast is dependent on the reliability of the assumptions regarding growth rates, and that deviations would necessitate corresponding revisions of the forecast.

The consumption of tonnage steel in 1968 is estimated at 1,253,000 tons, and of alloy steels at about 12,000 tons. This study estimates future demands to be as given in Table 1.

TABLE 1 - OVERALL STEEL DEMAND
(in million tons)

	1972	1977	1982
Finished steel - tonnage ..	1.621	2.502	4.286
- alloy ..	0.047	0.100	0.161
Total finished steel	1.668	2.602	4.447
Crude (liquid) steel - tonnage ..	2.026	3.127	5.358
- alloy ..	0.072	0.154	0.248
Total crude steel	2.098	3.281	5.606
Provision for defence & export of manufactured goods	0.105	0.395	0.936
Grand total demand	2.203	3.676	6.542
Installed capacity required	2.470	4.085	7.270

The validity of the total demand estimates was checked by independent demand projections made by other techniques such as time-trend analysis as well as simple and multiple regression analysis by correlation with appropriate economic indicators as shown in Table 2.

TABLE 2 - COMPARISON OF DEMAND ESTIMATES BY DIFFERENT METHODS
(in thousand tons)

Method of forecast	Projected demand estimate					
	Tonnage steel			Alloy steel		
	1972	1977	1982	1972	1977	1982
End-use ..	1 621	2 502	4 204	46.67	99.92	160.50
Time-trend ..	1 637	2 624	3 028	42.08	60.58	78.18
Simple regression:						
i) on national income ..	1 875	3 028	4 998	53.89	93.17	144.46
ii) on index of industrial production ..	1 642	2 928	4 967	42.94	76.27	129.15
Multiple regression:						
i) on index of industrial production and national income ..	1 619	2 488	3 477	55.60	87.20	138.18
ii) on index of industrial production and constructional activities ..	1 809	3 015	4 570	-	-	-

It will be observed that the demand assessment for tonnage steel by end-use approach agrees rather well with the time-trend and multiple regression forecasts while forecasts made by simple regression are also not far out. In the case of alloy steels, the forecasts by other methods do not agree well with end-use estimates except for some particular year or other, one reason being the inadequate statistical data on past imports of alloy steels on which the statistical forecasts are based.

The possibilities of steel exports have been examined and it is considered that Iran may not be in a position to export steel up to 1977; later some small quantities could be exported.

The substitution of tonnage steel by other materials due to technological trends and Government policies would be negligible for some years to come.

The demand, availability and shortfall of tonnage steel are shown in Table 3.

TABLE 3 - CATEGORYWISE DEMAND, AVAILABILITY AND SHORTFALLS OF TONNAGE STEEL
(In thousand tons)

	1972			1977			1982		
	Demand	Availability	Shortfall	Demand	Availability	Shortfall	Demand	Availability	Shortfall
A. Finished steel									
Structurals	391.64	25.00	- 366.64[a]	474.25	305.00	- 169.25	584.55	305.00	- 279.55
Flat products	822.06[b]	115.00	- 707.06	1 391.97	220.00	-1 171.97	2 486.12[b]	220.00	-2 266.12
Bars, rods and wires	213.28	225.00	+ 11.72[a]	420.04	415.00	- 5.04	768.57	415.00	- 353.57
Railway materials	80.47	-	- 80.47	72.02	5.00	- 67.02	123.16	5.00	- 118.16
Total	1 507.45	365.00[c]	-1 142.44	2 358.28	945.00[c]	-1 413.28	3 962.40	945.00[c]	-3 017.40
B. Ingot and semis	527.60[d]	-	- 527.60	731.25[d]	220.00	- 511.25	918.90[d]	220.00	- 698.90
Total shortfall			-1 670.04			-1 924.53			-3 716.30
C. Pipes and tubes[e]									
Welded	285.20	345.00	+ 59.80	438.28	453.00	+ 14.72	763.83	453.00	- 310.83
Seamless	110.90	-	- 110.90	141.00	-	- 141.00	252.72	-	- 252.72
Shortfall (pipes and tubes)			- 51.10			- 126.28			- 563.55

a/ - sign before the figure denotes a shortfall and + sign surplus.
b/ Includes plates, sheets and strips required for the production of welded pipes and tubes.
c/ Includes supply of 365,000 tons in 1972 and 515,000 tons in 1977 and also in 1982 by secondary producers.
d/ Also includes semis for seamless tubes.
e/ Pipes and tubes are not included in the total shortfall as flat products required for welded pipes and tubes have been considered under flat products and semis required for seamless tubes have been included under ingot and semis.

It is estimated that the total availability of finished and semi-finished steel will be 365,000 tons by 1972, 1,165,000 tons by 1977 and 1,165,000 tons by 1982 (without taking into consideration possible future expansion of the Isfahan steel plant). It will be noted that the shortfalls will be 1,670,000 tons in 1972, 1,925,000 tons in 1977 and 3,716,000 tons in 1982.

In the case of alloy steels, no assumptions on availability can be made at this stage as no concrete proposal for their indigenous production has been taken in hand. The entire estimated demand is the shortfall.

These shortfalls indicate the directions which planning for additional steel capacity in Iran should take. In the light of these shortfalls, setting up of additional capacity for structurals, a new steel plant for flat products, and a plant for the production of seamless tubes would need to be considered. In the case of alloy and special steels, a plant for the production of non-flat products would be worth considering to meet a substantial part of the demand.

The sustained development of the steel industry calls for the simultaneous development of many parallel, feeder and steel consuming industries. Profiles of twelve such industries relevant to Iranian conditions are presented for consideration.

Respectfully submitted
M.N. DASTUR & COMPANY PRIVATE LTD
by

M.N. Dastur, Managing Director

MND.nr

cc: Chief, Purchase and Transportation Services
United Nations
New York, N.Y. 10017
U.S.A.

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EXPLANATION OF SYMBOLS

Three dots (...) indicate that data are not available or are not separately reported.

A dash (-) indicates that the amount is nil or negligible.

A blank space ( ) in a table means that the item is not applicable.

A plus sign (+) indicates a surplus or an increase.

A minus sign (-) indicates a deficit or decrease.

A space between numerals is used to distinguish thousands and millions (1 246 869).

A full stop (.) is used to indicate decimals.

A stroke (/) indicates a crop year or fiscal years, e.g. 1953/1954

Use of a hyphen (-) between dates representing years, e.g. 1960-64 normally signifies an annual average for the calendar years involved, including the beginning and end years. 'To' between the years indicates the full period, e.g. 1960 to 1964 means 1960 to 1964, inclusive.

Reference to 'tons' indicates metric tons, and to 'dollars' United States dollars, unless otherwise stated.

Details and percentages in tables do not necessarily add up to totals, because of rounding.

1 - INTRODUCTION

Steel is closely linked to industrial progress and economic growth. With the great emphasis being placed on industrial expansion and diversification in Iran, steel is destined to play a major role in the years to come.

Iran's national development plans

Iran has embarked on a long-term programme of industrialisation, the main objectives of which are to make the country less dependent on foreign sources in respect of consumer goods, to produce within the country capital and intermediate goods so as to progressively cut down the volume of imports, and to diversify the export of locally manufactured goods which would reduce the present dependence of the economy on oil revenues.

Accordingly, Iran's Fourth National Development Plan (1968-1972) envisages an average annual growth rate of 15 per cent in the industrial sector and 17 per cent in the mining sector. As a result, the contribution of industry and mining to the Gross National Product at the end of the Fourth Plan period is expected to rise from 14.1 per cent to 17.3 per cent.

1 - Introduction (cont'd)

Investment in industry and mining

The scale of economic effort and investment required to achieve this target is best illustrated by a review of the sectoral allocations to the industrial and mining sectors during the Fourth Plan. Compared to the Third Plan capital investment of Rials 70 billion, the total fixed investment in industries and mining (excluding oil) is expected to reach the figure of Rials 213 billion during the Fourth Plan. Of this, about Rials 170 billion will be invested in metallurgical and mining, mechanical and electrical engineering, tractor and automobile, chemical and petrochemical industries. The total investment in the oil and gas sector would be Rials 105.8 billion.

Steel and economic growth

An industrial development programme of this magnitude would require substantial steel inputs, for the reason that steel enters into the construction of all production equipment and machinery, power stations and transmission lines, dams and bridges, railway lines, transport vehicles and equipment. A definite correlation therefore exists between economic development and steel consumption.

1 - Introduction (cont'd)

Industrial inputs for agriculture

Increase in agricultural production also calls for increased technological inputs to raise the productivity of Iranian agriculture - better farm implements and machinery for cultivation, earthmovers and graders for developing the land and for building irrigation works, chemical fertilisers and pesticides to improve yields, machinery to process the products and vehicles to move them to the markets. Such rapid expansion in agriculture cannot take place in isolation: industrial growth must proceed simultaneously to provide the required technological inputs for agricultural development.

With the strengthening of the economic infrastructure during the earlier Plans and the setting up of basic industries such as steel, petrochemical, machine building and aluminium, a sizeable industrial base for the domestic production of industrial machinery, transport and electrical equipment and a wide range of consumer durables, is being created in the country. Rapid progress in this direction as envisaged in the Fourth Plan would necessitate increased consumption of steel.

Iran has some of the raw materials and the infrastructure required for the production of steel. Moreover, in view of the strategic importance of steel, it would be logical to

1 - Introduction (cont'd)

develop her steel industry at the earliest and achieve self-sufficiency to the extent possible. Given the techno-economic conditions, Iran should be able to produce steel economically by the maximum exploitation of locally available raw materials.

Need for long-term planning in steel

As installation of new steel capacity together with infrastructure and the development of ancillary facilities such as new mines, washeries, water supply, railways etc is a time-consuming process (extending in many cases from 6 to 10 years), planning for steel must necessarily be done in long time spans. Consequently the Fourth Plan should be concerned as much with advance preparation connected with steel development in the subsequent plans as with the achievement of the Fourth Plan targets.

The necessity of taking a long-term view of the development process and treating it as a smooth continuing endeavour rather than one broken into distinct short time intervals has to be constantly borne in mind, if planning is to be successful.

Immediate needs are often so urgent and the benefits of perspective planning seem so remote that the need for an additional steel plan or power plan 8 to 10 years hence

may not appear to demand urgent consideration. But the penalty for failing to take decisions at the right time to initiate advance action may be heavy in the future.

It needs to be appreciated that the mere formulation of a target for steel or any other key sector is not enough. Detailed studies need to be undertaken at the technical level to work out the implications of the target and define the appropriate steps that need to be simultaneously initiated to make possible integrated progress over a wide front. In the absence of such detailed and co-ordinated studies under competent technical aegis, shortfalls, delays and high costs of production will occur which will make orderly progress towards targets impossible.

Authorisation

This report has been prepared in accordance with the scope of work indicated in contract No. 29/69 dated 25th June 1969 with the United Nations acting on behalf of the United Nations Industrial Development Organisation and subsequent amendment No. 2 dated 11th December 1969. The terms of reference relevant to this study are given in Appendix 1-1.

1 - Introduction (cont'd)

A Draft Report was presented in May 1970. Detailed comments were received on this from UNIDO staff in Teheran and Vienna as well as from the Research Centre of the Ministry of Economy. The Consulting Engineers team visited Teheran from 23rd September to 3rd October 1970 to discuss the Draft Report. Points made in those discussions have been kept in mind while finalising this report.

Structure of the report

The report presents an analysis of the expected demand for steel, including alloy and tool steels, in 1972, 1977 and 1982. Based on the pattern of future demand and probable indigenous production in various categories, the shortfalls have been estimated. Development of infra-structure, raw materials and supplies, and intermediate and auxiliary industries to consume steel products are briefly dealt with.

The report containing nine chapters is presented in four volumes. Volume I contains the Introduction, Summary and Conclusions and Classification of Steel. Volume II details with Past Consumption and Present Demand for Steels, and Methodology of Demand Forecast and Field Survey. In Volume III, the Demand Analysis is presented, while Export Possibility and Substitution, Analysis of Shortfalls and Development of Steel Industry are discussed in Volume IV.

1 - Introduction (cont'd)

Acknowledgment

His Excellency Dr M. Yeganeh, former Deputy Minister of Economy, His Excellency Dr Najmabadi and His Excellency Dr Ashrafi of the Ministry of Economy, the Imperial Government of Iran, had discussions with the teams of the Consulting Engineers and made valuable suggestions for which we are thankful.

The Consulting Engineers gratefully acknowledge the cooperation and help extended by Dr A. Nagaraja Rao and Dr R.A. Abuelhadj and other United Nations experts in Teheran, Mr Soltani, Mr Sohanaki, Mr Shahoon and other officials of Ministry of Economy, and many other Government and private agencies in Iran listed in Appendices 1-2 and 5.1.

2 - SUMMARY AND CONCLUSIONS

1. This report presents a study of the demand for tonnage steel and alloy steels in Iran by 1972, 1977 and 1982, the final years of the Fourth, Fifth and Sixth plan periods respectively. The probable future availability and the resultant shortfalls of steel are reviewed.

2. Integrated steel plants and alloy steel plants are complex undertakings with long gestation periods. As steel is indispensable to industrial progress, it is essential that appropriate steps are initiated well in advance to meet the future demands of industrial development. The demand study is a necessary prelude to work in this direction.

Background

3. Iran's first integrated steel plant, now under erection at Isfahan, has an initial capacity of 500,000 to 600,000 tons of finished steel, with provision for further expansion. This study would help in making decisions on the magnitude and phasing of the expansion of Isfahan plant and setting up of other steel plants.

2 - Summary and conclusions (cont'd)

Tonnage steel

Classification

4. Steel may be broadly classified into two categories, carbon (tonnage) steel and alloy steel. Tonnage steel products containing not more than 0.8 per cent carbon are generally produced in large integrated plants in the ready-to-use state. The commercial forms and quality associated with each steel product and its principal applications are reviewed in Chapter 3.

Products covered

5. The products covered by this study are the following:

Structurals	-	Beams, angles, channels, tees.
Flat products	-	Plates, hot rolled sheets/strips, cold rolled sheets/strips, tin plates, galvanised sheets.
Railway materials	-	Rails, other railway materials such as fishplates, dogspikes, fish bolts, wheels, tyres and axles.
Others	-	Seamless and welded pipes and tubes, wires, bars and rods.

Past consumption and present demand

Direct imports

6. Till now there has been no indigenous primary steel production in Iran. Recently some steel rolling mills and a welded pipe plant based on imported steel semis have been installed. The Isfahan steel plant is expected to go into production by 1972. Therefore, the

2 - Summary and conclusions (cont'd)

steel requirements of the country hitherto have been met entirely by imports either in the form of finished products (such as beams, angles, plates, sheets) or in the form of semi-finished products (such as billets to be re-rolled into finished products). To meet the growing domestic demand, direct imports of tonnage steel have risen from 347,000 tons in 1962 to 1,365,000 tons in 1968, as given in Table 2-1.

Table 2-1

DIRECT TONNAGE STEEL IMPORTS - 1962 TO 1968

Year	Direct imports '000 tons
1962	347
1963	356
1964	505
1965	685
1966	720
1967	1 216
1968	1 365

Indirect imports

7. Indirect imports are in the form of manufactured items such as machinery, machine parts and components, fabricated items like steel structures, tanks and vessels, automobiles and other transport equipment, domestic appliances, engineering goods etc. In keeping with the long-term industrialisation plan, Iran will gradually produce machinery and equipment which are hitherto

2 - Summary and conclusions (cont'd)

imported and consequently the percentage of indirect imports to total steel consumption of the country will gradually diminish. On the basis of norms of steel content of imported machinery and equipment, indirect steel imports have been estimated (Table 2-2).

Table 2-2

INDIRECT IMPORTS OF STEEL a/

Year		Amount tons
1962	..	146 000
1963	..	143 000
1964	..	206 000
1965	..	257 000
1966	..	303 000
1967	..	304 000
1968	..	481 000

a/ About 5 per cent is alloy and special steels.

Past consumption

8. In view of the absence of indigenous capacity for primary steel production and negligible steel exports (only some small quantity of pipes have been exported to Pakistan and Saudi Arabia in the past two years), the apparent consumption of Iran may be assumed as equivalent to imports.

9. In order to assess future steel demand, an understanding of the pattern of steel consumption in the past is

essential. This has been estimated by field survey and 'end-use' method (in which the consumption norm per unit is applied to total production of each steel consuming item). The major economic sectors consuming steel are:

A. Transport equipment

B. Electrical equipment

C. Industrial and agricultural machinery

D. Metal products

E. Constructional and allied activities in various economic sectors.

10. The consumption of tonnage steel by the major consuming sectors for the year 1968 is estimated in Chapter 4 and shown in Table 2-3.

Regional pattern of consumption

11. At present the bulk of the steel consumed in Iran (over 60 per cent) is utilised in Teheran area and the remaining 40 per cent is distributed primarily in larger cities where there are large concentrations of people (Table 2-4).

2 - Summary and conclusions (cont'd)

Table 2-3

TOTAL STEEL CONSUMPTION BY SECTORS, 1968

		Steel consumption tons
Transport equipment	..	37 000
Electrical equipment	..	8 000
Industrial and agricultural machinery		2 000
Metal products	..	315 000
		362 000
Pipes, tubes and fittings for IGAT project and other oil, gas and water distribution network	..	366 000
Sub-total	..	728 000
Spares and maintenance work @ 10%	..	73 000
Sub-total	..	801 000
Construction and allied activities		488 700
Total	..	1 289 700
Stock @ 2%	..	26 000
		1 315 700
Non-coverage	..	37 700
		1 353 400

2 - Summary and conclusions (cont'd)

Table 2-4

REGIONAL PATTERN OF STEEL CONSUMPTION

Principal areas		Consumption of steel %
Teheran	..	60
Isfahan	..	10
Ahwaz	..	10
Arak	..	5
Tabriz	..	5
Others	..	10
Total		100

Alloy steels

12. With increasing indigenous production of plant and equipment, Iran's requirements of alloy steels used in their manufacture is likely to increase. There is no indigenous capacity for production of these steels at present. In the interest of the national economy, Iran should now take steps to meet a substantial proportion of her alloy steel requirements from indigenous sources. This demand study and a feasibility report for an alloy steel plant concurrently taken in hand, are the first steps in this direction.

13. All steps other than tonnage steel can be grouped under alloy steels. These steels are required in comparatively small tonnages. Quality requirements are

8 - Summary and conclusions (cont'd)

high, and rigid quality control at all stages of manufacture is essential. Therefore, these steels are often made in plants much smaller in size than tonnage steel plants. Operations start with steelmaking, usually in electric arc furnace, with steel scrap as the basic raw material.

Products

14. Alloy steels are required mostly in the form of bar products (rolled or forged), except in the case of (i) stainless steels, the bulk of which are required as flat products, and (ii) electrical grade silicon steels, the entire demand for which is in thin gauge (26 G and 29 G) sheets.

Classification

15. Major alloy steel types, specifications, compositions, treatment and applications are dealt with in Chapter 3 and Appendices 3-2 and 3-3.

Imports

16. The direct imports of alloy steels from 1962 to 1966 are given in Table 8-6.

Table 8-6

IMPORTS OF ALLOY AND SPECIAL STEELS

Year		Quantity tons
1962	..	206
1963	..	688
1964	..	1 877
1965	..	3 514
1966	..	3 978
1967	..	25 800
1968	..	26 404

2 - Summary and conclusions (cont'd)

Unaccountable increase in imports

17. Statistics indicate a sudden spurt in imports of alloy steel from about 4,000 tons in 1966 to over 35,000 tons in 1967. An examination of import statistics suggests that about 6,000 tons steel wire and about 25,000 tons of sheets have been wrongly included under alloy and special steels. Excluding this tonnage, imports of alloy steels in 1968 would amount to about 7,000 tons only. The imports of spring steel (about 3,000 tons) and of carbon construction steel (2,000 tons in 1968) are not included in the category of alloy steels in the official statistics. Taking into consideration these tonnages as well, the total imports of alloy steels in 1968 would amount to 12,000 tons.

Consumption

18. As there is no indigenous production of alloy steels, past and present imports can be taken as representing consumption levels.

Methodology of demand forecasting

Selection of forecasting techniques

19. Long term projections for a material like steel have to take into account practically every aspect of the planning of the entire economy. There are various methods for forecasting steel demand, ranging from simple empirical to more complex statistical techniques. The selection of a particular method depends on factors

2 - Summary and conclusions (cont'd)

such as the nature of the product under study, the level of economic development, the structure of the economy, the extent to which statistical data are available and the time span of the projection. In an expanding economy like Iran, the rapidly changing pace and pattern of growth as well as the structural changes taking place rule out the adoption of forecasting methods employed in industrially advanced countries with a long history of steady development.

End-use method

20. Of the methods available for estimating future demand, the 'end-use method' has the best cogency in an economy planned for rapid growth. This is based on projections for the growth of industries manufacturing steel consuming items and constructional activities in other economic sectors as well as the technical norms of steel consumption per unit of output. Since this method takes into account foreseeable changes, structural as well as technological, it possesses a high degree of validity in a growing economy.

Steps in end-use method

Identification of steel consuming items and sectors

21. The first step in the end-use method is to identify the end uses of steel in various sectors of the economy. For estimating the demand for tonnage and alloy steels,

2 - Summary and conclusions (cont'd)

seventy-six manufactured items were identified as accounting for practically the entire consumption in the industrial sectors. In addition, constructional activities in the following eleven sectors also require tonnage steel:

Large and medium industries
Agriculture and allied activities
Oil and gas
Irrigation
Roads and bridges
Social services
Telecommunication
Airports
Ports and harbour
Power supply
Rail transport.

Output levels

22. The next step is the forecast of levels of output/development of steel-using industries and sectors.

Norms of consumption

23. The third step is to ascertain the gross quantity of steel (including processing loss) going into each unit of steel consuming items manufactured by the industrial sectors or each unit of investment in constructional and allied activities in other economic sectors.

Demand estimation

24. Finally, by applying the norms of consumption to the output levels of each steel-consuming area, the sector-wise and total steel requirements are estimated.

2 - Summary and conclusions (cont'd)

Field survey

25. The study was based primarily on field survey which covered most of the existing large manufacturing and consuming industries. Detailed lists of industries/ firms in each major industrial group were drawn up on the basis of data available in Industrial Guide to Iran, List of Manufacturing Industries published by the Ministry of Economy, Iran Chamber of Commerce Directory and other trade directories and publications. The lists were supplemented by information from agencies such as the Plan Organisation, Industrial Development and Renovation Organisation of Iran, Industrial and Mining Development Bank of Iran and Bank Markasi.

Coverage

26. Based on discussions with the Statistical Department of the Ministry of Economy, firms which consume little or no steel were eliminated.

Response to questionnaires

27. Interviews were conducted on the basis of three separate questionnaires - one for tonnage steel consuming industries, one for alloy and special steel consuming industries, and one for steel importers:

Questionnaire sent out	- 280
Direct interviews	- 100

2 - Summary and conclusions (cont'd)

In addition, various government and non-government agencies, major steel importers and stockists were also contacted.

Non-coverage

28. Field survey data on output levels were compared item by item with available official statistics and suitable adjustments made to allow for non-coverage.

Output levels of manufactured items

29. In the case of items currently under manufacture, output levels by 1972 and 1977 could be estimated on the basis of field survey data. To estimate future output levels of items for which capacity is now under implementation or active consideration, the Plan programmes were taken into account. In this manner anticipated output levels could be derived up to 1977, but for 1982 projections had to be made on the basis of growth rates calculated from trends up to 1977.

Projection of constructional and allied activities

30. Of the eleven economic sectors considered, specific Plan programmes are available for rail transport and power supply up to 1982. For the remaining nine sectors, investment levels in the Fourth Plan period only were available. Investments in 1977 and 1982 had to be estimated on the basis of growth rates of related economic indicators calculated from past data, as

2 - Summary and conclusions (cont'd)

indicated below:

Item	Economic indicator	Growth rate % a/ 1967 to 1972	1972 to 1977	1977 to 1982
Large and medium industries	Index of industrial production	13.0	12.0	11.0
Agricultural and allied activities	National income	9.4	8.5	7.5
Oil and gas	Index of industrial production	13.0	12.0	11.0
Irrigation	National income	9.4	8.5	7.5
Roads and bridges	Index of industrial production	13.0	12.0	11.0
Social services	National income	9.4	8.5	7.5
Telecommunication	National income	9.4	8.5	7.5
Airports	National income	9.4	8.5	7.5
Ports and harbours	National income	9.4	8.5	7.5

a/ It is to be noted that the growth rates used here are for estimating investments only in constructional and allied activities in the respective sector and not for the growth rate of the sector as a whole.

Need for cross-checking

31. As the accuracy of output forecasts is important to the entire exercise, it is necessary to cross-check the estimated output levels with independent estimates by employing alternative statistical techniques such as regression and time-trend analysis.

2 - Summary and conclusions (cont'd)

Forecast by alternative methods

32. Out of the total seventy-six manufactured items considered for estimating steel demand, suitable series for time-trend and regression analysis could be developed for 38 items (34 for tonnage steel and four exclusively for alloy steels). Projections derived from the equations established were compared with forecasts obtained by field survey as well as plan programme to ensure that the forecast levels adopted were realistic. The 34 steel consuming items for which forecast comparisons were possible, account for over 75 per cent of total tonnage steel consumption for manufactured items. Therefore, the tonnage steel demand estimated on this basis is expected to have a reasonable degree of validity.

Norms of consumption

33. Once the output levels of various consuming items are determined, the appropriate consumption norm is applied to them. For a majority of items, the norms of consumption were established on the basis of actual consumption for manufactured items by industries contacted during the field survey. While in the case of tonnage steel the consumption norm is

broken down into product categories, in the case of alloy steels it has been determined by steel types. For some items where a precise breakdown of consumption norms could not be obtained from the industrial units, as well as for items which are only to be manufactured in future, consumption norms were evolved on the basis of production practices prevailing in other comparable countries.

34. Reliability of such forecasts will depend to a great extent on the correctness of the assumptions made. For the purpose of this study, the following assumptions have been made:

Assumptions

i) The production of different steel consuming items for which output forecasts have been based on Plan programmes will materialise according to Plan.

ii) The growth rate of national income will be 9.4 per cent a year between 1967 and 1972, 8.5 per cent between 1972 and 1977 and 7.5 per cent between 1977 and 1982. The index of industrial production will increase at the rate of 13 per cent per annum between 1967 and 1972, 12 per cent between 1972 and 1977 and 11 per cent between 1977 and 1982.

iii) Population will increase at the rate of 2.8 per cent a year.

2 - Summary and conclusions (cont'd)

iv) For the industries yet to be developed, norms of steel consumption derived from like items in other countries at a similar stage of development will also hold good for Iran.

v) Investment policies in different economic sectors as outlined in the National Development Plan and other related documents issued by the Imperial Government of Iran will be followed.

vi) There will be little substitution of steel by other materials before 1982. In building construction, r.c. construction will progressively replace steel frame construction in future, as a result of general government policy now being implemented.

vii) The investments in different economic sectors during each plan period will be more or less equally phased over each year of the plan period.

viii) It is also assumed that projections obtained by correlating the average annual investment levels in the different economic sectors during the Fourth Plan period with the envisaged growth rates of the related economic indicators in the Fifth and Sixth Plan periods will hold good as reasonably valid estimates of the average annual investment levels in those sectors during the Fifth and Sixth Plan periods.

Demand analysis

Steel demand by sectors

35. The sectorwise finished steel demand estimated on the basis of the end-use study is given in Table 2-6.

The total estimated demand for tonnage steel is

2 - Summary and conclusions (cont'd)

1.465 million tons in 1972, 2.199 million tons in 1977 and 3.557 million tons in 1982.

Table 2-6

SECTORWISE TONNAGE STEEL DEMAND (ALL CATEGORIES)[a]
(with due allowance for non-coverage)

		1972 tons	1977 tons	1982 tons
A.	Transport equipment	92 676	207 647	366 648
B.	Electrical equipment	40 584	69 705	145 479
C.	Industrial and agricultural machinery	32 184	86 471	140 977
D.	Metal products	596 306[b]	880 960[c]	1 521 351[d]
E.	Constructional and allied activities	703 009	956 066	1 382 841
	Total	1 464 759	2 198 849	3 557 396

a/ Excluding stock, spares and maintenance, small scale industries, defence, substitution and export requirements. Also excludes alloy and special steels.
b/ Includes 120,000 tons of semis for seamless tubes.
c/ Includes 150,000 tons of semis for seamless tubes.
d/ Includes 260,000 tons of semis for seamless tubes.

Spares and maintenance, small scale industries and stock

36. The demand for tonnage steel given in Table 2-6 excludes the requirements for (1) spares and maintenance, (2) small scale industries and (3) stocks. These are determined on the basis of prevailing percentage ratios and are estimated at 157,000 tons in 1972, 289,000 tons in 1977 and 487,000 tons in 1982.

37. When these are added, the overall requirements of tonnage steel are given in Table 2-7 and shown in Fig 2-1.

2 - Summary and conclusions (cont'd)

Table 2-7

OVERALL REQUIREMENT OF STEEL BY PRODUCT CATEGORIES a/

Category		1972 tons	1977 tons	1982 tons
Structurals				
Beams	..	252 605	257 948	210 376
Channels	..	55 961	82 267	117 540
Angles	..	79 056	127 254	238 206
Tees	..	4 029	6 778	13 126
Sub-total	..	391 651	474 247	579 248
Flat products				
Plates	..	171 970	282 896	495 849
C.R. sheets/strips	..	225 992	451 224	851 885
H.R. sheets/strips	..	252 379	365 078	687 778
Tinplates	..	54 193	66 852	82 790
Galvanised sheets	..	39 006	96 516	131 663
Sub-total	..	743 540	1 262 566	2 254 965
Others				
Bars and rods	..	200 744	397 656	717 225
Wires	..	12 545	22 376	30 664
Pipes and tubes	..	53 202	97 281	183 226
Sub-total	..	266 491	517 313	931 115
Semis b/	..	138 600	176 250	315 900
Railway materials				
Rails	..	41 056	36 728	62 780
Other materials	..	39 413	35 271	60 380
Sub-total	..	80 469	71 994	123 160
Total	..	1 620 751	2 502 371	4 204 323
Rounded off	..	1 621 000	2 502 000	4 204 000

a/ Excluding defence, substitution and export requirement
b/ Semis for seamless tubes.

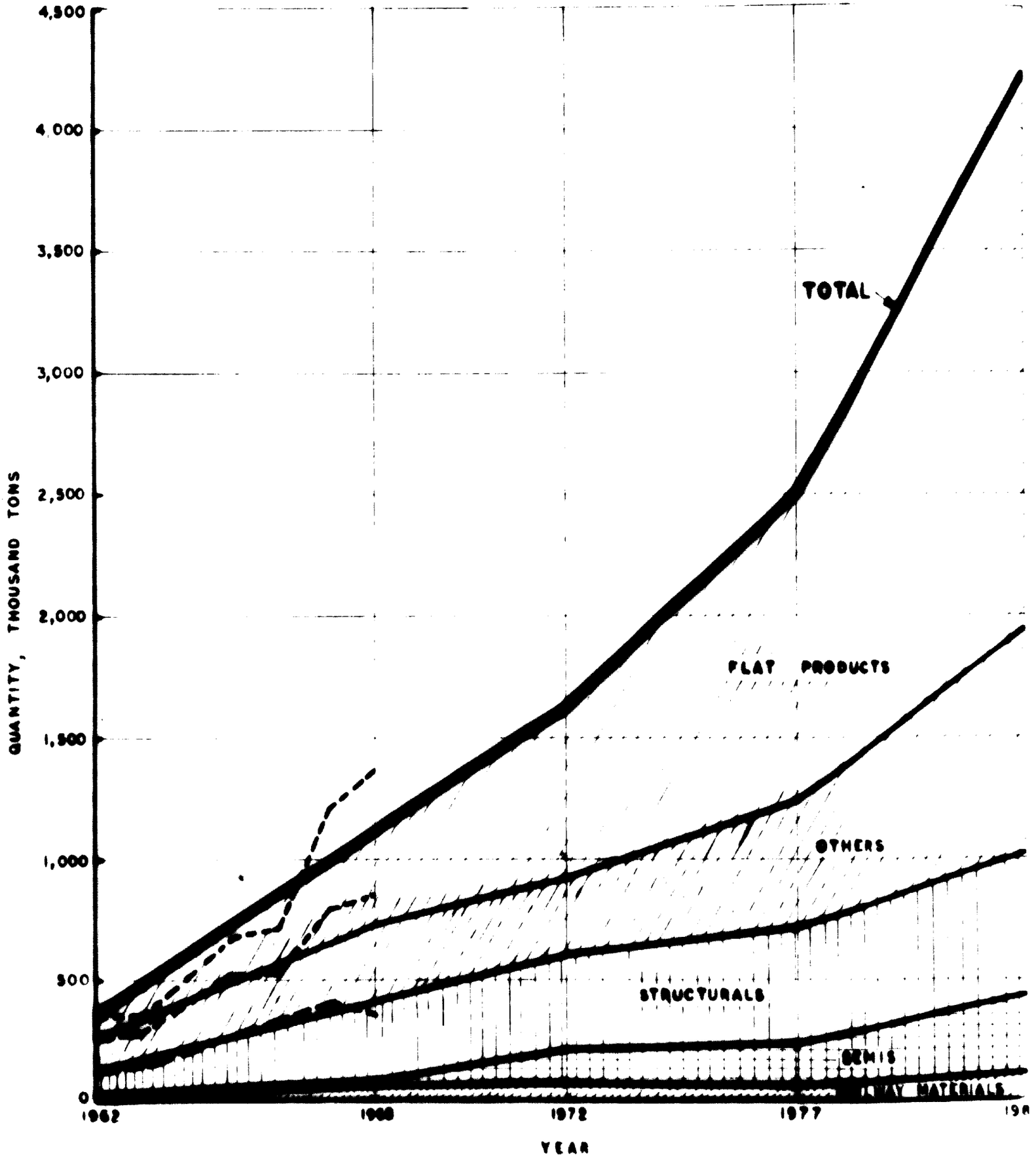


FIG. 2-1: CATEGORYWISE TOTAL TONNAGE STEEL DEMAND

2 - Summary and conclusions (cont'd)

38. It may be noted from Fig 2-1 that the increase in the demand for flat products is much greater than for semis, railway materials and 'others' (bars, rods, wires, pipes and tubes). The reason for this is the rapid growth anticipated in automobile, railway rolling stock and household appliance industries, which are the principal consuming industries for flat products. Moreover, the production of welded pipes, for which plates, sheets/skelp will be required, is also expected to increase substantially. In the case of structurals, due to the effect of substitution of steel structurals for construction purposes by reinforced concrete, the demand wouldnot rise appreciably.

39. The requirement of steel given in Table 2-7 indicates a growth rate of 9.1 per cent during the period 1972 and 11.1 per cent during the period 1977.

Comparison of tonnage steel demand forecasts

40. The validity of the aggregate demand estimates given in Table 2-7 has been checked against independent projections of overall demand by other accepted techniques such as time-trend and regression analysis. For regression analysis, both simple and multiple regression equations were worked out with the economic indicators indicated below as independent variables.

2 - Summary and conclusions (cont'd)

Simple regression - a) national income
b) index of industrial production

Multiple regression - a) national income and index of industrial production
b) constructional activity and index of industrial production.

The aggregate demand projections arrived at by different methods are compared with estimates by the end-use method in Table 2-2 and plotted in Fig 2-2.

48. It will be observed that the total tonnage steel demand estimated by end-use approach agrees rather well with the forecasts made by time-trend and multiple regression while the forecasts made by simple regression are also not far out.

49. From Fig 2-2 it may be noted that the end-use forecast curve agrees closely with the multiple regression analysis curve on index of industrial production and national income in the earlier years and fall in between the multiple regression analysis curve on index of industrial production and national income and the multiple regression analysis curve on index of industrial production and constructional activity in the later years. The time-trend curve agrees approximately with the end-use curve.

Table 2-6

CONFRONTATION OF TURKISH STEEL DEMAND PROJECTIONS BY DIFFERENT METHODS

(Thousands of tons)

Year	Method of forecast					
	Mid-term	Time trend	Simple regression: On national income	Simple regression: On index of industrial production	Multiple regression: On index of industrial production and national income	Multiple regression: On index of industrial production and constructional activities
1972	1 681	1 657	1 875	1 642	1 619	1 805
1977	2 502	2 624	3 028	2 988	2 488	3 015
1982	4 204	5 800	4 988	4 987	3 477	4 570

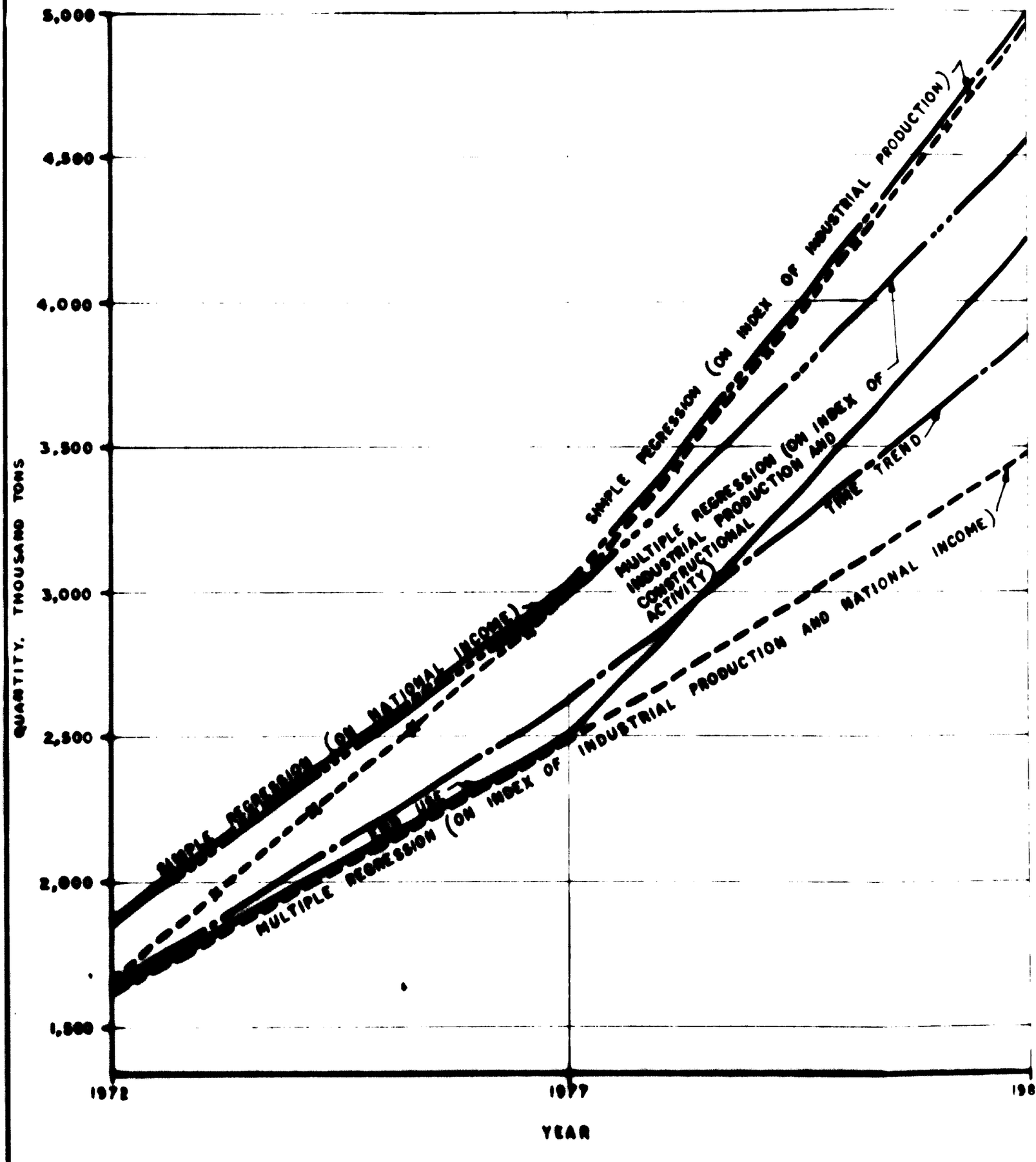


FIG. 2-2: TOTAL TONNAGE STEEL DEMAND—FORECASTS BY VARIOUS METHODS

2 - Summary and conclusions (cont'd)

Sectorwise alloy steel demand

45. The demand for alloy steels has been estimated on the same basis as that of tonnage steel, namely by applying the consumption norms to the output levels of alloy steel consuming items. The consumption norms were derived by field survey and from production practices followed in other developing countries. The demand estimates are given in Table 2-9.

Table 2-9

SECTORWISE ALLOY STEEL DEMAND a/
(Thousands of tons)

Consuming sector	Requirement 1972	1977	1982
Transport equipment ..	20.34	41.85	68.95
Electrical equipment ..	5.47	10.26	15.78
Industrial and agricultural machinery ..	6.39	16.09	25.02
Metal products ..	5.82	12.56	17.05
Total ..	38.02	80.76	126.78

a/ Excluding spares and maintenance, small scale industries, stock, defence, substitution and export requirements.

Spares and maintenance, small scale industries and stocks

44. The requirements of alloy steels for spares and maintenance, small and medium scale industries and stocks have been calculated on the basis of percentage ratios of the requirements for manufactured items. The ratio adopted for spares and maintenance is 10 per cent and for stocks 2 per cent. For small and medium scale

industries values of 4, 6 and 10 per cent have been taken for the three years respectively.

Tool steel requirements

45. The proportion of tool steel has been estimated at 6, 5 and 4 per cent of the alloy steel requirements of the manufacturing sectors which works out to 5,4 and 3,1 per cent respectively of the total requirements of alloy steel in 1972, 1977 and 1982. The over all tonnage of tool steel consumed will rise, but expressed as a percentage of total alloy steel consumption, it will go down due to the manufacturing processes utilising tools becoming more rapid and continuous.

Die blocks

46. The requirements of die blocks used for forging have been estimated on the basis of expected output of forgings. It is expected that forgings will be about 2 per cent of the total tonnage steel demand and that about 10 tons of die blocks will be required for every 1 000 tons of forgings, as given in Table 2-10.

Table 2-10

REQUIREMENT OF DIE BLOCKS

Year	Total tonnage steel demand '000 tons	Demand for forgings a/ tons	Requirement of die blocks tons
1972	1 620	32 400	324
1977	3 000	60 000	600
1982	4 200	84 140	841

a/ 2% of tonnage steel demand

2 - Summary and conclusions (cont'd)

Overall demand of alloy steels

47. The aggregate demand for alloy steels by types after incorporating the requirement for spares and maintenance, small scale industries, stocks, tool steel and die blocks is given in Table 2-11 and shown in Fig 2-5. The demand will be 46,700 tons in 1972, 99,800 tons in 1977 and 160,800 tons in 1982.

Table 2-11

TOTAL REQUIREMENT OF ALLOY STEELS

(Thousands of tons)

Type of steel		1972	1977	1982
Carbon constructional	..	5.75	9.15	15.25
Free cutting	..	1.82	4.27	7.42
Spring	..	15.54	27.07	45.24
Alloy constructional	..	16.49	38.14	60.29
Stainless	..	4.75	9.72	16.07
Electrical sheet	..	5.72	7.07	10.57
Tool	..	2.28	4.00	5.04
Die blocks	..	0.32	0.50	0.84
Total	..	46.67	99.92	160.80

48. The sharp rise in demand by 1972 and the subsequent years shown in Fig 2-5 indicates rapid growth anticipated in the manufacture of alloy steel consuming items. Large increase in demand for alloy constructional steels and spring steels are expected due to production of railway rolling stock, auto engines, springs for automobiles and wagons etc.

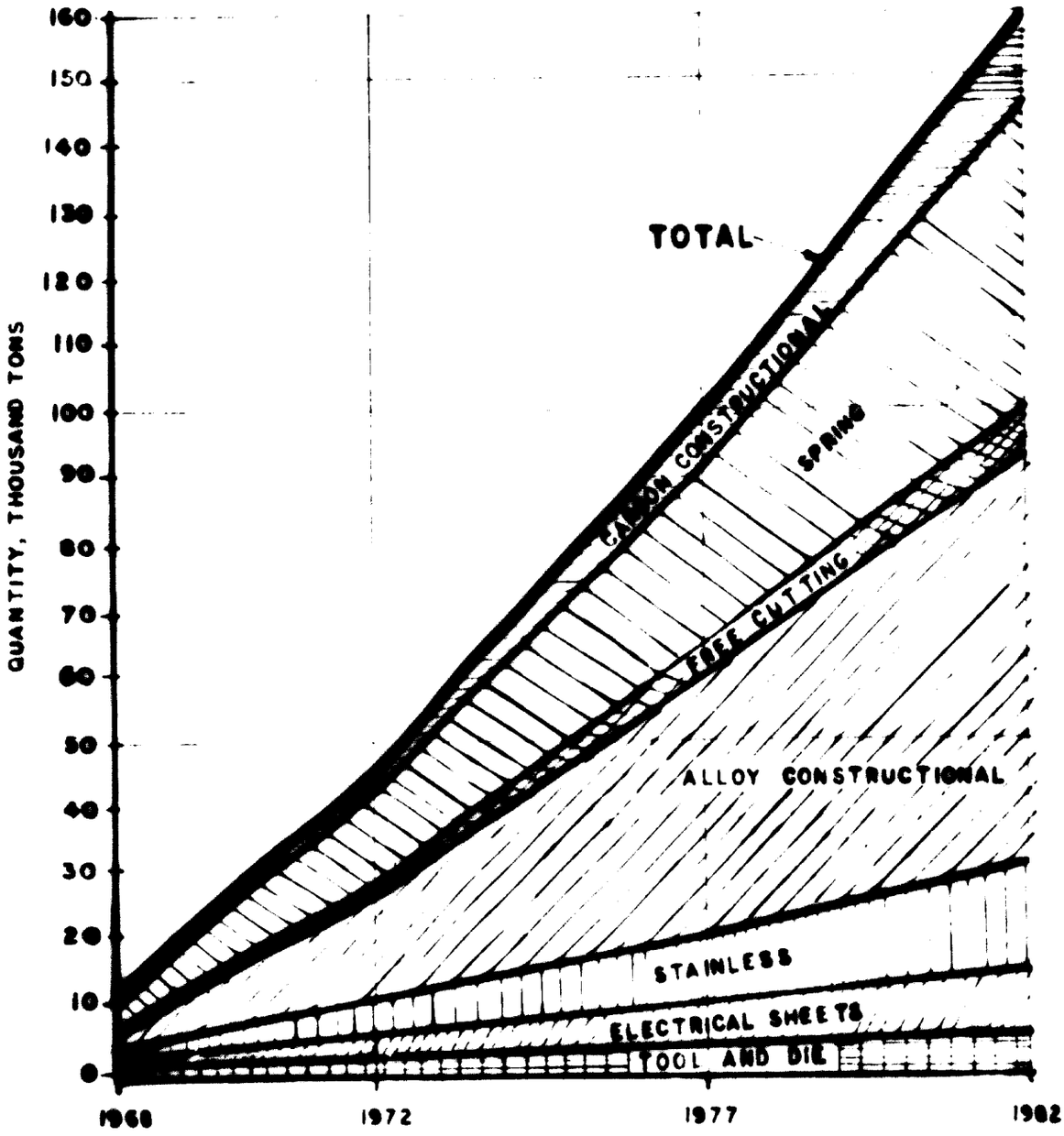


FIG. 2-3: TOTAL ALLOY STEELS DEMAND BY TYPES

2 - Summary and conclusions (cont'd)

Alloy steel ingot requirements

49. Alloy steel manufacture will probably continue to be based on ingot practice for sometime to come. Taking 65 per cent yield from ingot to finished steel, alloy steel ingot requirements will be 71,800 tons in 1972, 154,000 tons in 1977 and 247,000 tons in 1982. The estimated average growth rate for alloy steels between the period 1968 and 1982 is 10.4 per cent. This high growth rate is the result of a low starting base, there being only a few alloy steel consuming industries at present - but many more of these industries are likely to come up in future.

Comparison of alloy steel demand forecasts

50. The validity of the aggregate demand estimates of alloy steels arrived at by the end-use method were checked by comparison with independent projections made by other techniques - time-trend analysis as well as simple and multiple regression analysis. In case of regression analysis the independent variables chosen are given below:

Simple regression - a) national income
b) index of industrial production

Multiple regression - National income and index of industrial production.

The projections derived by these techniques are given in Table 2-12 and plotted in Fig 2-4.

2 - Summary and conclusions (cont'd)

Table 2-12

ALLOY STEEL DEMAND: COMPARISON OF PROJECTIONS BY DIFFERENT METHODS

(Thousands of tons)

Year	End-use	Time-trend	Simple regression a/	Simple regression b/	Multiple regression c/
1972	46.67	42.06	55.89	42.94	55.60
1977	99.92	60.58	93.17	76.27	87.20
1982	160.50	78.18	144.46	129.15	138.18

a/ National income as independent variable
b/ Index of industrial production as independent variable
c/ National income and index of industrial production as two independent variables.

51. The aggregate demand forecasts by other methods do not agree well with the estimates made by end-use method except for some particular year or other, one reason being the inadequate and confusing statistical data on imports of alloy steels during the past on which the forecasts are based. The forecasts by the end-use method, based on identification and detailed analysis of alloy steel consuming items and micro-level projections of the same are considered to be the more acceptable.

52. Fig 2-4 shows graphically that the demand projections made by other methods do not agree well with projections made by the end-use method, though the simple

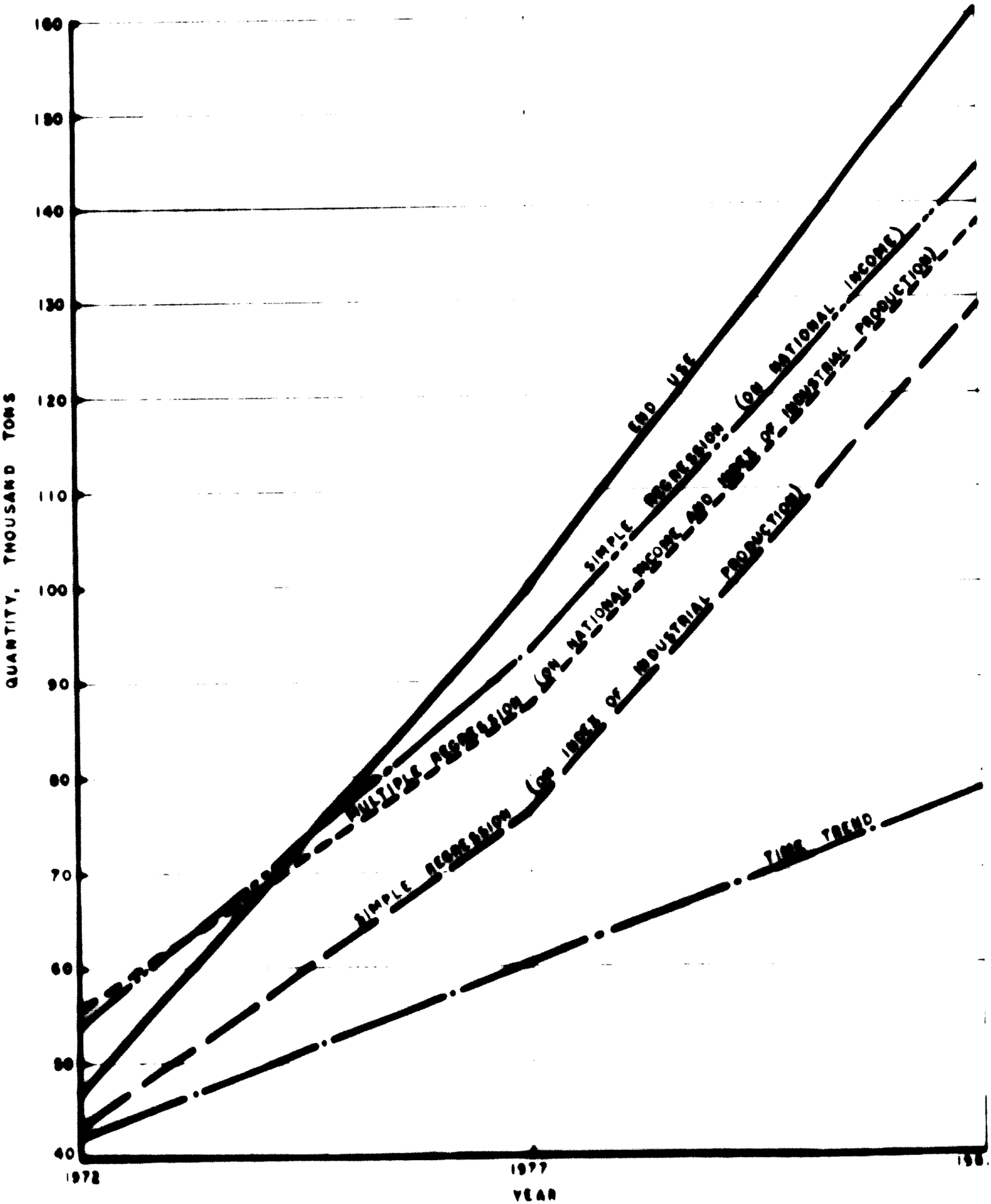


FIG. 2-4 ALLOY STEELS DEMAND—FORECASTS BY VARIOUS METHODS

regression line with national income as independent variable and multiple regression line with national income and index of industrial production as two independent variables are close. The disparity is due to the fact that while the end-use approach is based on micro-level projections taking into account probable structural changes in the economy, the macro-level projections by other methods can be realistic only in the case of developed economies with fairly stabilised trends which are likely to continue in future, and where reliable data on past consumption are available over long periods.

[redacted]

Import potential for [redacted] steel

88. The possibility of export of tonnage steel by Iran has been reviewed. As the Isfahan steel plant is expected to go into operation only by 1972, significant exports may not be possible even up to 1977. The possibility of exporting steel to neighbouring countries like Pakistan and Turkey, with whom Iran has an agreement on regional co-operation for development (RCD), have been reviewed in Chapter 7. It is envisaged that Turkey's entire steel requirements will be met by her own production and therefore Iran's exports may have to be restricted mainly to Pakistan for some time.

8 - Summary and conclusions (cont'd)

Considering probable indigenous requirements of steel by Pakistan in 1982, it is estimated that Iran may be able to export about 100,000 tons of tonnage steel to that country.

Export potential for alloy steel

84. The proposal for an alloy steel plant is in the feasibility report stage at present. Even if a decision were taken in the near future to put up the plant, it will take another four years or more before the plant is commissioned. Even then, Iran will have to continue to import some varieties of alloy steels to meet fully her domestic demand. Initially exports may be only marginal.

Substitution

85. The substitution of tonnage steel by other materials in various sectors has been reviewed from the point of view of Government policy and technological trends. Little substitution is expected by 1972 and 1977 on considerations of both price and indigenous availability of substituting materials such as plastics, aluminium etc. It is estimated that by 1982 substitution may reduce tonnage steel demand by say 10,000 tons. In the case of alloy steels, substitution by other materials is not considered probable even by 1982.

2 - Summary and conclusions (cont'd)

Net demand of tonnage steel

86. The net demand of tonnage steel after deducting the substitution by other materials and adding the tonnage of export would amount to 1,621,000 tons by 1972, 2,808,000 tons by 1977 and 4,286,000 tons by 1982.

Net demand of alloy steels

87. In case of alloy steels, the net demand will be the same as the total demand given in Table 2-11 as there will be neither substitution nor export.

Overall requirement of iron and steel

Total crude steel

88. The total crude steel demand including the requirement for defence and export of manufactured goods, is estimated in Chapter 8 and summarised in Table 2-15.

Table 2-15

OVERALL CRUDE STEEL DEMAND

(in million tons)

		1972	1977	1982
Finished steel demand	..	1.068	2.602	4.067
Equivalent crude steel	..	2.026	3.281	5.008
Provision for defence	..	0.106	0.220	0.350
Requirement for export of manufactured goods	..	0	0.166	0.272
Total crude steel	..	2.132	3.671	5.630

Capacity required

89. As steel production would be only about 80 per cent of installed capacity, the capacities to be planned are 2.670, 4.589 and 7.050 million tons respectively.

8 - Summary and conclusions (cont'd)

60. The demand for finished castings of both engineering and non-engineering sectors are summarised below:

	(In thousand tons)		
	[illegible]	[illegible]	[illegible]
Grey iron castings ..	80.00	130.00	208.00
Malleable iron castings	[illegible]	[illegible]	[illegible]
Total iron castings	[illegible]	[illegible]	[illegible]
Steel castings	5.00	9.00	15.00

Requirement of iron

61. The total iron required in 1972, 1977 and 1982 for steelmaking, as well as for iron castings is estimated at 3,000, 3,400 and 6,165 million respectively. In estimating this demand the requirement for steel castings has not been considered, as the steel required for these castings is usually melted from scrap in small furnaces by the foundries themselves.

Country comparison

62. The per capita steel consumption and per capita income derived from the estimated values of total crude steel requirement, population and national income of Iran in 1972, 1977 and 1982 are given below:

Year	Per capita income	Per capita steel consumption
	$	kg
1972	450	75
1977	600	101
1982	800	104

I. [illegible] and conclusions (cont'd)

The estimated per capita steel consumption levels are higher than those in developing countries and lower than in developed countries for the corresponding per capita incomes.

[illegible]

[illegible]

68. At present there are no primary producers of tonnage steel or of alloy and special steels. Taking into consideration the production programme of ISP/SAIL and secondary producers, the availability of finished and semi-finished steel is estimated at about 300,000 tons by 1976, 1,100,000 tons by 1977 and 1,100,000 tons by 2000. In the case of alloy and special steels, no concrete proposal for manufacturing has been taken in hand so far.

69. The demand, availability and shortfall of tonnage steel broken down into product categories are given in Table 8.68. The alternative breakdown of shortfalls is given in Table 8.69. The shortfalls are expected to be about 1,070,000 tons in 1976, 1,000,000 tons in 1977 and 1,710,000 tons in 2000. The demand, availability and shortfalls of pipes and tubes (for which the details are furnished in Table 8.70) are given separately in Table 8.71.

Table 2-14

CATEGORYWISE AVAILABILITY, DEMAND & SHORTFALL OF T
(in thousands of tons)

	1972			1977		
	Demand	Availability	Shortfall	Demand	Availability	Shor
A. Finished Steel						
Steel mills						
Rails ..	252.61	-	-252.61 a/	257.95	234.00	+
Channels ..	55.96	-	-55.96	82.27	11.00	-
Angles ..	79.04	20.00	-59.04 a/	127.25	55.00	-
Tees ..	4.03	5.00	+0.97	6.78	5.00	
Sub-total	391.04	25.00	366.04	474.25	305.00	-1
Flat products b/						
Plates ..	171.98	-	-171.98	282.90	-	-2
CR sheets/strips ..	240.99	-	-240.99	466.22	-	-4
HR sheets/strips..	296.08	100.00	-196.08	479.48	205.00	-2
Tinmill ..	54.00	-	-54.00	68.85	-	-
Galvanised ..	59.01	15.00	-44.01	96.56	15.00	-
Sub-total ..	822.06	115.00	-707.06	1 391.97	220.00	-1 1
Others						
Bars and rods ..	200.74	210.00	+9.26 a/	397.66	400.00	
Wires ..	12.55	15.00	+2.45 a/	22.38	15.00	
Sub-total	213.29	225.00	+11.71	420.04	415.00	
Raising materials						
Scrap ..	41.04	-	-41.04	36.72	5.00	-
Other raising materials	39.43	-	-39.43	35.30	-	-
Sub-total	80.47	-	-80.47	72.02	5.00	-
Total finished steel	1 507.06	365.00 c/	-1 142.45	2 358.28	945.00 c/	-1 4
B. Ingots and semis d/ ..	527.60	-	-527.60	721.93	220.00	-
Total shortfall e/ ..			-1 670.05			-1 9

a/ Indicates surplus
b/ Includes plates, sheets and strips required for the production of welded pipes and tubes.
c/ Includes supply of 365,000 tons in 1972 and 945,000 tons in 1977 and also in 1982 by secondary pr
d/ Includes quantity of semis required by secondary producers and also semis for seamless tubes.
e/ Pipes and tubes are not included in the total shortfall as flat products required for welded pipes have been considered under flat products and semis required for seamless tubes have been include ingot and semis. The requirements of pipes and tubes are as follows:

	1972			1977				
	Demand	Availability	Shortfall	Demand	Availability	Shortfall	Demand	Av
Welded ..	395.80	345.00	+50.80	438.28	453.00	+14.72	707.00	
Seamless ..	110.90	-	-110.90	141.00	-	-141.00	852.72	
Shortfall (pipes and tubes)			-51.10			-126.28		

Table 2-14

Table 2-14

CATEGORYWISE AVAILABILITY, DEMAND & SHORTFALL OF TONNAGE STEEL
(in thousands of tons)

1972		1977			1982		
Availability	Shortfall	Demand	Availability	Shortfall	Demand	Availability	Shortfall
-	-252.61	257.95	234.00	+23.95	214.38	234.00	+19.62
-	-55.96	82.27	11.00	-71.27	119.54	11.00	-108.54
30.00	-59.06	127.25	55.00	-72.25	237.55	55.00	-182.55
5.00	+0.97	6.78	5.00	-1.78	13.08	5.00	-8.08
35.00	366.04	474.25	305.00	-169.25	584.55	305.00	-279.55
-	-171.98	282.90	-	-282.90	496.59	-	-496.59
-	-240.99	466.22	-	-466.22	856.63	-	-856.63
00.00	-196.08	479.48	205.00	-274.48	94.43	205.00	-689.43
-	-54.00	68.85	-	-68.85	82.79	-	-82.79
15.00	-44.01	96.56	15.00	-81.52	155.67	15.00	-140.67
15.00	-707.06	1 391.97	220.00	-1 171.97	2 486.12	220.00	-2 266.12
10.00	+9.86	397.66	400.00	+2.34	717.91	400.00	317.91
15.00	+2.45	22.38	15.00	-7.38	50.66	15.00	-35.66
25.00	+11.71	420.04	415.00	-5.04	768.57	415.00	-353.57
-	-41.04	36.78	5.00	-31.72	62.78	5.00	-57.78
-	-19.43	35.30	-	-35.30	60.38	-	-60.38
-	-30.47	72.08	5.00	-67.02	123.16	5.00	-118.16
65.00	-1 142.45	2 350.28	245.00	-2 413.88	3 968.40	245.00	-3 917.40
-	-527.60	721.25	220.00	-611.25	816.80	220.00	-696.80
	-1 670.05			-2 025.13			-2 714.20

for the production of welded pipes and tubes.
515,000 tons in 1977 and also in 1982 by secondary producers.
ary producers and also semis for seamless tubes.
al shortfall as flat products required for welded pipes and tubes
nd semis required for seamless tubes have been included under
s and tubes are as follows

SECTION 2

1977				1982		
Shortfall	Demand	Availability	Shortfall	Demand	Availability	Shortfall
-59.80	458.78	458.00	-315.78	767.88	458.00	-316.88
10.90	141.00	-	-141.00	267.78	-	-267.78
-51.10			-196.28			-584.66

Table 2-15

SECTORAL BREAKDOWN OF SHORTFALLS IN DIFFERENT CATEGORIES

(in thousand tons)

Category	Sizes	1972	1977	1982
Structurals				
Beams		252.61	23.95	+19.62 a/
	a) 100 x 50 - 150 x 80	27.17	-	-
	b) 175 x 90 - 250 x 125	66.44	-	-
	c) 300 x 140 - 450 x 150	140.00	-	-
	d) Above 450 x 150	19.00	-	-
Channels		55.96	71.27	108.54
	a) 30 x 33 - 60 x 45	9.00	12.60	25.54
	b) 100 x 50 - 150 x 75	21.96	28.17	33.00
	c) 175 x 75 - 400 x 100	25.00	30.50	45.00
Angles		58.08	72.25	132.55
i) Equal angles		48.42	58.00	150.00
	a) 20 x 20 - 90 x 90	38.79	43.60	120.00
	b) 100 x 100 - 130 x 110	4.70	5.90	13.00
	c) 130 x 130 - 200 x 200	6.00	9.50	17.00
ii) Unequal angles		10.50	13.25	18.55
	a) 30 x 20 - 60 x 40	2.00	2.50	5.25
	b) 85 x 65 - 125 x 75	5.00	7.50	13.80
	c) 125 x 90 - 200 x 150	3.50	4.25	10.50
Tees		20.27 b/	1.79	3.08
Subtotal		366.64	139.25	279.55
Flat products				
Plates		171.98	282.90	496.59
	a) 900 - 1 100 width	55.50	88.30	193.50
	b) 1 250 - 1 600 width	90.28	150.00	230.00
	c) 1 800 - 2 795 width	26.20	44.60	70.09
C.R. sheets/strips		240.99	466.22	856.53
	a) 600 - 1 100 width	180.00	325.00	590.50
	b) 1 200 - 1 525 width	60.99	141.22	266.13
H.R. sheets/strips		196.08	274.48	581.43
	a) 600 - 1 100 width	175.00	235.00	575.00
	b) 1 200 - 1 525 width	21.08	39.48	114.43

Annex 2 - Summary Tables and Projections (cont'd)

Plates		171.28	282.90	196.59
	a) 900 - 1 100 width	55.50	88.30	190.50
	b) 1 250 - 1 500 width	90.28	150.00	430.00
	c) 1 800 - 2 700 width	25.20	44.60	70.09
C.R. sheets/strips		260.88	446.22	855.58
	a) 600 - 1 100 width	180.00	385.00	590.50
	b) 1 200 - 1 525 width	80.99	141.22	266.13
L.R. sheets/strips		196.88	274.66	682.63
	a) 600 - 1 100 width	195.80	295.00	575.00
	b) 1 200 - 1 525 width	21.08	30.40	114.43
Tinplates		56.00	66.85	82.79
Galvanized sheets		98.01	85.52	140.67
Subtotal		777.26	1 171.97	2 [illegible]
[illegible]				
Bars and rods		29.26	29.26	317.91
1) Rounds and squares		-	-	[illegible]
	a) below 12	-	-	105.30
	b) 12 - 50	-	-	110.50
	c) above 50	-	-	84.30
11) Flats		-	-	33.11
	a) 25 - 50 width	-	-	35.00
	b) 50 - 125 width	-	-	10.20
	c) 125 - 250 width	-	-	12.21
Shapes		2.66	2.26	35.56
Subtotal		31.91	5.01	353.57
[illegible]				
Rails		21.21	21.72	57.28
Other railway items		20.62	25.20	52.38
Subtotal		50.47	57.08	111.16
Angle and cranks		287.60	311.25	548.20
Total		1 050.24	1 545.38	3 716.20
[illegible]		1 050.00	1 545.00	3 716.00

[illegible]

8 - Summary and conclusions (cont'd)

Table 8-16

PIPES AND TUBES: DEMAND, AVAILABILITY AND SHORTFALLS BY TYPES

(In thousand tons)

Items of tubes	1974	1977	1981
Seamless tubes			
Demand	110.90	141.00	252.72
Availability	-	-	-
Shortfall	-110.90	-141.00	-252.72
Welded pipes and tubes			
Demand	226.20	438.28	767.86
Availability	345.00	453.00	453.00
Shortfall	+118.80 a/	+14.72	-314.86
Total shortfall	-51.10	-126.28	-567.58

a/ + denotes surplus
- denotes shortfall

68. Productions and total shortfalls of tonnage steel, including the shortfalls of ingots and semis, are shown in Fig 8-6. The total shortfall increases only by about 200,000 tons from 1974 to 1977, the reason being that 600,000 tons of indigenously produced steel (430,000 tons of finished materials and 70 000 tons of billets from Isfahan steel plant, and 150,000 tons of continuous cast billets from Iranian Rolling Mills Company) are expected to become available between 1974 and 1977.

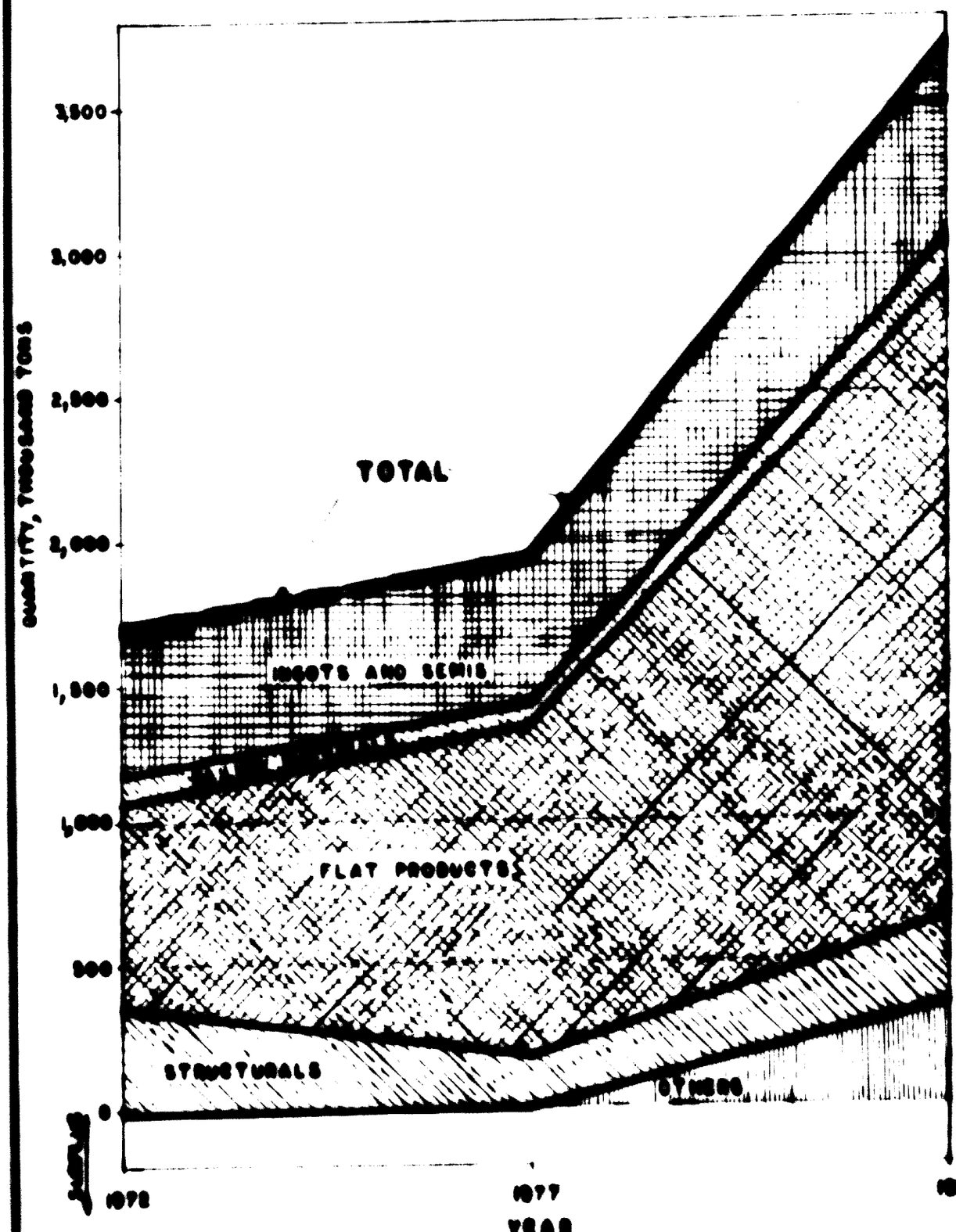


FIG. 2-3: SHORTFALLS OF TONNAGE STEEL

8 - Summary and conclusions (cont'd)

66. The shortfalls indicate the direction which planning for additional steel capacity in Iran should take. In the light of these shortfalls, setting up of additional capacity for structurals, a new steel plant for flat products, and a plant for the production of seamless tubes would need consideration.

Breakdown of shortfall of alloy steels

67. In the case of alloy steels, shortfalls will be the same as the total demand given in Table 8-11. Shortfalls of each type of steel, broken down into flat and non-flat products, are given in Table 8-17. A plant for alloy steel non-flat products could be considered.

Table 8-17

SHORTFALLS OF ALLOY STEELS IN FLAT AND NON-FLAT CATEGORIES

(in thousand tons)

Type of steel	1970			1971			1980		
	Non-flat	Flat	Total	Non-flat	Flat	Total	Non-flat	Flat	Total
Carbon constructional	3.48	0.30	3.78	8.89	0.96	9.85	13.80	1.73	15.53
Free cutting	1.06	-	1.06	4.87	-	4.87	7.42	-	7.42
Spring	13.80	0.24	13.94	26.80	0.87	27.67	43.00	2.84	45.84
Alloy constructional	24.80	1.90	26.60	38.60	4.84	38.14	58.60	7.80	66.8
Stainless	1.86	3.80	4.76	3.82	6.70	9.78	4.87	11.80	16.07
Electrical sheet	-	3.78	3.78	-	7.87	7.87	-	10.37	10.37
Tool	1.60	0.66	2.26	3.60	1.00	4.60	3.90	1.14	5.04
Die blocks	[illegible]	-	[illegible]	[illegible]	-	[illegible]	[illegible]	-	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

2 - Summary and conclusions (cont'd)

Candidate projects

Development of steel industry

60. No other material can compare with the versatility and low cost of steel for engineering applications. In any country, establishment of the steel industry on a firm footing marks the take-off point for numerous light, medium and heavy engineering industries. Balanced development of these industries can be best ensured by long term perspective planning for each development sector. Some important aspects of this planning are discussed below.

61. The targets for development of steel and related industries for years 1977 and 1982 selected on the basis of this demand study are shown in Table 2.10. Technological inputs of critical importance for rapid and balanced development of steel and related industries are:

i) raw materials
ii) services like power, transport and utilities, and
iii) trained manpower

Raw materials

62. The requirements of major raw materials for achieving the selected production targets are summarized in Table 2.11.

Table 5-18

SELECTED PRODUCTION TARGETS FOR STEEL AND FOUNDRY INDUSTRIES

Item	1987 Annual Approach tons	1987 Production Target Liquid steel tons	1987 Production Target Finished products tons	1992 Annual Approach tons	1992 Production Target Liquid steel tons	1992 Production Target Finished products tons
Foreign steels						
1) Integrated, ore base	2.80 million	3.0 million	2.6 million	4.2 million	5.0 million	4.0 million
2) Semi-integrated, scrap based		180 000	135 000		300 000	270 000
Alloy steel	80 000	90 000	60 000	180 000	150 000	100 000
Steel castings	9 000	15 000	7 800	15 000	24 000	12 000
Malleable iron castings	14 000		10 000	26 000		18 000
Grey iron castings (industrial and engineering castings)	140 000		80 000	240 000		150 000
Ferro-alloys						
Ferro-manganese	48 000		28 000	54 000		36 000
Ferro-silicon 75% grade	11 000		17 000	18 000		17 000
Ferro-chrome						
Low carbon	300		10 000	600		10 000
High carbon	-		4 500	-		4 500

[illegible]		180 [illegible]	185 000		[illegible]	[illegible]
[illegible]	80 000	80 000	60 000	180 500	150 000	100 000
[illegible]	6 000	15 000	7 000	15 000	24 000	12 000
[illegible]	16 000		20 000	25 000		18 000
[illegible] (chromium and [illegible])	140 000		80 000	240 400		150 000
[illegible] of						
[illegible] of	48 000		30 000	54 000		36 000
[illegible] of 75% grade	11 000		17 000	10 000		17 000
[illegible] of						
low carbon	200		10 000	600		10 000
high carbon	-		4 500	-		4 500

[illegible] The [illegible] for ferro-alloys are as under, set in table 10-65 and 10-66.

[illegible] The [illegible] of ferro-manganese production over [illegible] is mainly [illegible] to export of a [illegible] in earn foreign exchange [illegible] -- 1979

[illegible] The surplus of ferro-silicon and ferro-chrome [illegible] over the [illegible] mainly for export.

[redacted]

8 - Summary and conclusions (cont'd)

Table 8-10

[redacted] INPUTS OF MAJOR RAW MATERIALS

	[redacted]	[redacted]
[redacted]		
[redacted]		
[redacted] ore (60% Fe)	4 [redacted]	4 [redacted]
Iron ore pellets/1 shop grade	[redacted]	[redacted]
Pig iron	[redacted]	[redacted]
Steel scrap	[redacted]	[redacted]
Cast iron scrap	[redacted]	[redacted]
Malleable iron scrap	[redacted]	[redacted]
[redacted]		
[redacted] ore (low grade)	[redacted]	[redacted]
[redacted] ore (60% Fe content)	[redacted]	[redacted]
[redacted] ore (high Mn)	[redacted]	[redacted]
[redacted]		
[redacted] (high Fe)	[redacted]	[redacted]
[redacted]		
[redacted]	8 [redacted]	4 [redacted]
Coke	[redacted]	[redacted]
Charcoal	[redacted]	[redacted]
[redacted]		
[redacted] furnace grade limestone	[redacted]	1 [redacted]
Standard/1 shop grade limestone	[redacted]	[redacted]
Dolomite	[redacted]	[redacted]
Manganese	[redacted]	[redacted]
[redacted]		
[redacted] - 75% grade	[redacted]	[redacted]
Ferromanganese - 75% grade	[redacted]	[redacted]
Ferrosilicon	[redacted]	[redacted]
[redacted]		
[redacted] fuel	[redacted]	[redacted]
Electricity	[redacted]	[redacted]
Chromite ores	[redacted]	[redacted]
[redacted]		
[redacted]	[redacted]	[redacted]
Other refractory bricks	[redacted]	[redacted]

8 - Summary and conclusions (cont'd)

The present status of the reserves of raw materials such as iron and manganese ores, chromite, coal, limestone etc, in Orissa are briefly mentioned in Chapter II. The development of these mineral resources would call for intensive geological investigations and studies of mining methods.

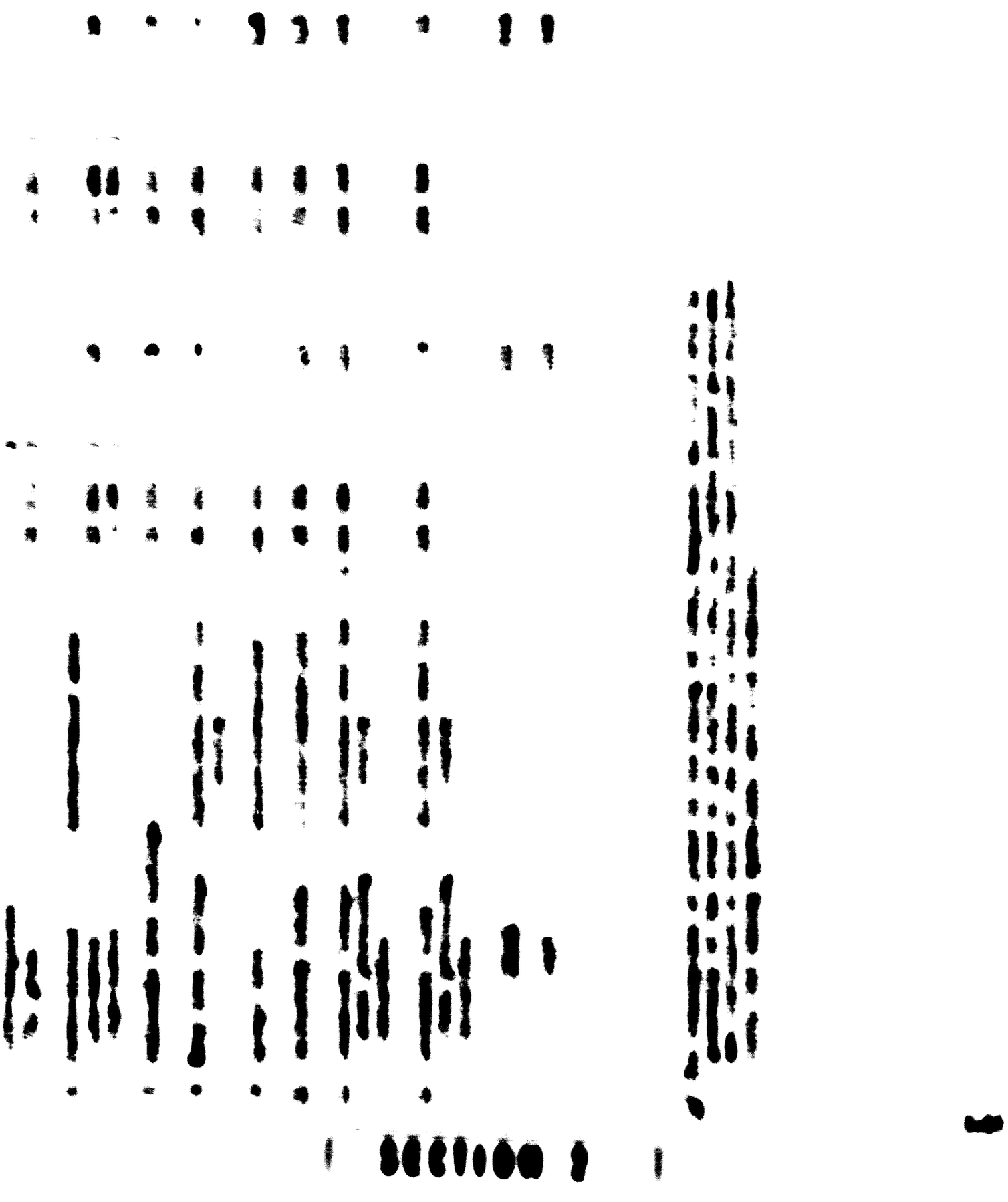
Power requirements

9. The power requirements for different iron and steel industries are shown in Table 8.10. With the installation of large-scale generating stations in various regions and their linkup to the national grid it is probable that bulk power required by these industries would be available.

Transport facilities

10. Steel industry imposes special demands on rail track and facilities. The anticipated traffic in tonnage that will be generated by development of the industry are summarised in Table 8.11. The requirements of railway and road corridors to handle goods traffic of this magnitude are given in Table 8.12. Construction programmes for development of roads and railways will have to take these requirements into consideration.

[redacted]



3 • SUMMARY AND CONCLUSIONS (cont'd)

Table 3-24

ANTICIPATED VOLUME OF GOODS TRAFFIC
(All figures are in thousand tons)

Item	[illegible] Production	[illegible] Traffic	[illegible] Production	[illegible] Traffic
Foreign steel ore-based	3 000	11 000	5 000	20 000
Foreign steel electric furnace	100	200	200	400
Alloy steel	60	100	200	300
Steel castings	7.5	25	15	50
Ferro-silicon • 50% grade	20	40	30	60
Ferro-manganese • 75% grade	20	100	30	150
Low-carbon ferro-chrome	10	20	10	20
High-carbon ferro-chrome	4.5	15	4.5	15
Tungsten iron castings	10	20	10	20
Cast iron castings	60	150	100	250
Foreign iron by Int. transmit	200	200	200	200
Refractory fireclay	30	60	70	150
Unspecified [illegible] of foreign steels	3 000	3 000	4 000	4 000
Unspecified [illegible] of alloy steels	60	60	100	100
Miscellaneous products from steel mills	100	[illegible]	1 000	[illegible]
Total		[illegible]		[illegible]

[illegible]

[redacted]

[redacted]

[redacted]

I - Summary and evaluations (cont'd)

[redacted]

[redacted]	[redacted]	[redacted]	[redacted]
[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

[redacted]

[redacted]

[illegible] (cont'd)

[illegible]

96. The sophisticated technologies adopted in modern [illegible] and [illegible] plants call for a strong cadre of trained and resourceful technical and managerial personnel to operate them. The [illegible] requirements for steel, [illegible] and [illegible] industries are presented in Table [illegible]. It will be seen from this table that [illegible] and steel [illegible] industries will require by 1971 roughly [illegible] times the manpower required by the steel [illegible] industry. [illegible] training and [illegible] of these personnel is [illegible]. [illegible] emphasis should also be laid on developing a skilled cadre of [illegible] engineers and technicians.

[illegible]

97. [illegible] steel projects [illegible] and [illegible] planning for construction [illegible] to [illegible] the [illegible] schedule. A [illegible] estimate of the requirements of [illegible] construction [illegible] is [illegible] up in Table [illegible].

[illegible]

98. [illegible], [illegible] are [illegible] to the development of the steel industry [illegible]. [illegible]

Table [illegible]

ESTIMATE OF MANPOWER REQUIREMENT FOR STATE AND STATE-CONTRACT

Purpose of requirement		Total	Additional requirement			
			Total		Out of which	
			Short-term training		Short and medium duty inspection	
		Number	Per cent	Number	Per cent	Number	Per cent
1) [illegible]							
[illegible]	..	[illegible]	0.80	...	...	[illegible]	[illegible]
[illegible]	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2) [illegible]							
[illegible]	..	[illegible]	[illegible]	...	...	[illegible]	[illegible]
[illegible]	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3) [illegible]							
[illegible]	..	[illegible]	[illegible]	...	...	[illegible]	[illegible]
[illegible]							
[illegible]	..	[illegible]	[illegible]	...	...	[illegible]	[illegible]
[illegible]	..	[illegible]	[illegible]	...	...	[illegible]	[illegible]
[illegible]	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[redacted]

[redacted]

[illegible] (cont'd)

[illegible]

[illegible]

1) [illegible]
2) [illegible]

[illegible]

1) [illegible]
2) [illegible]
3) [illegible]
4) [illegible]

[illegible]

1) [illegible]
2) [illegible]
3) [illegible]
4) [illegible]
5) [illegible]
6) [illegible]
7) [illegible]
8) [illegible]

[illegible]

[illegible] [illegible]

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[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
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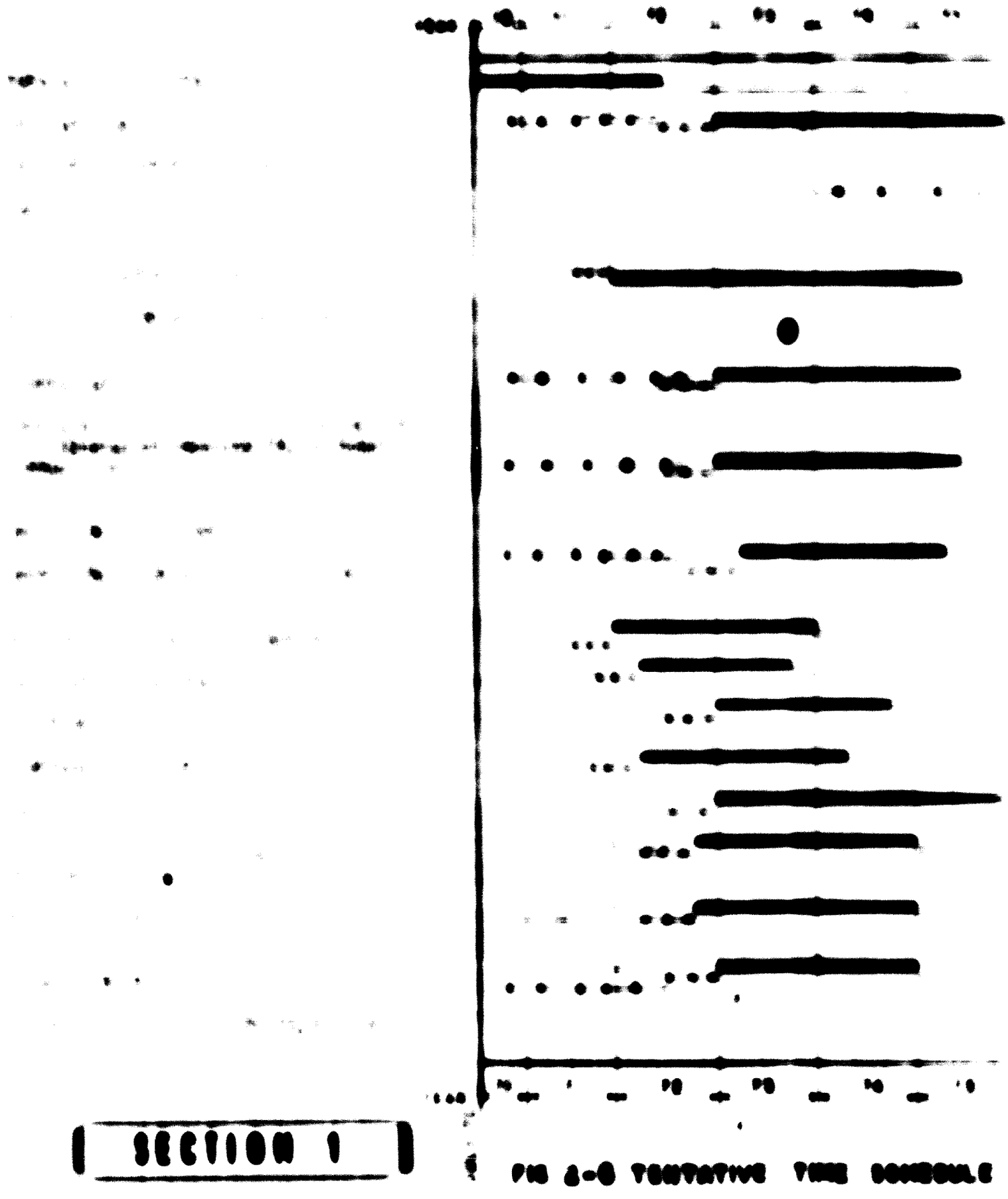

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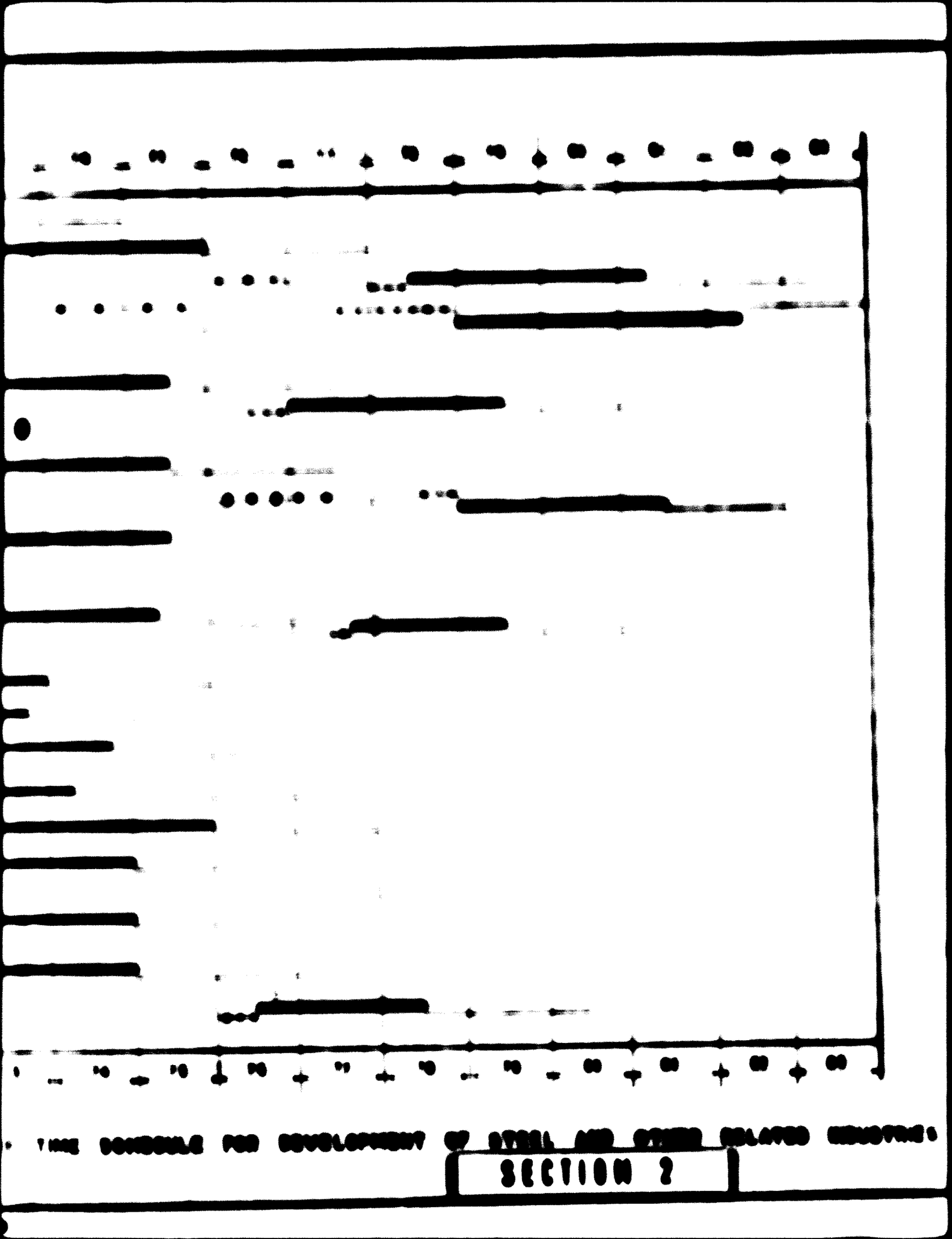

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SECTION 3

EEL AND OTHER RELATED INDUSTRIES

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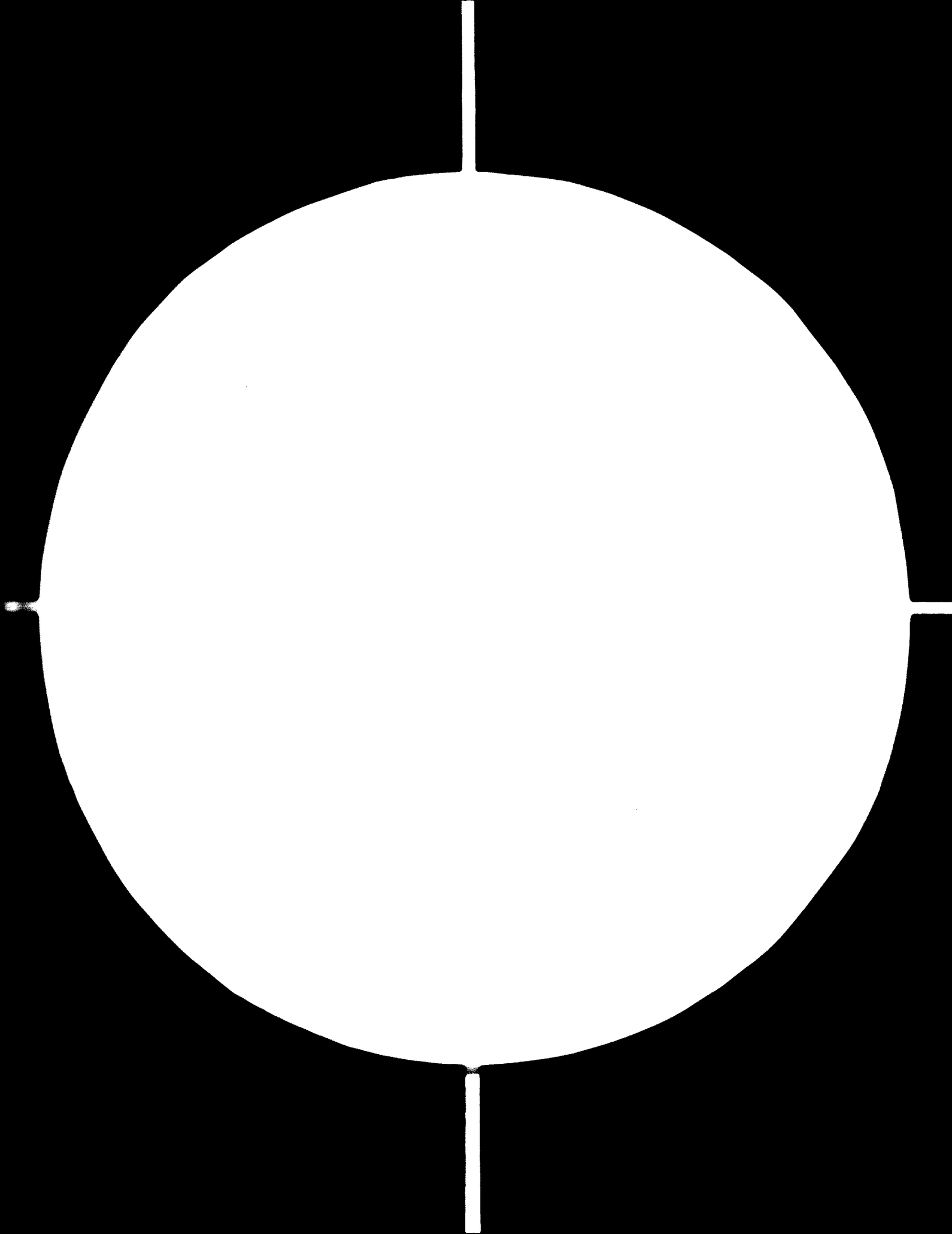

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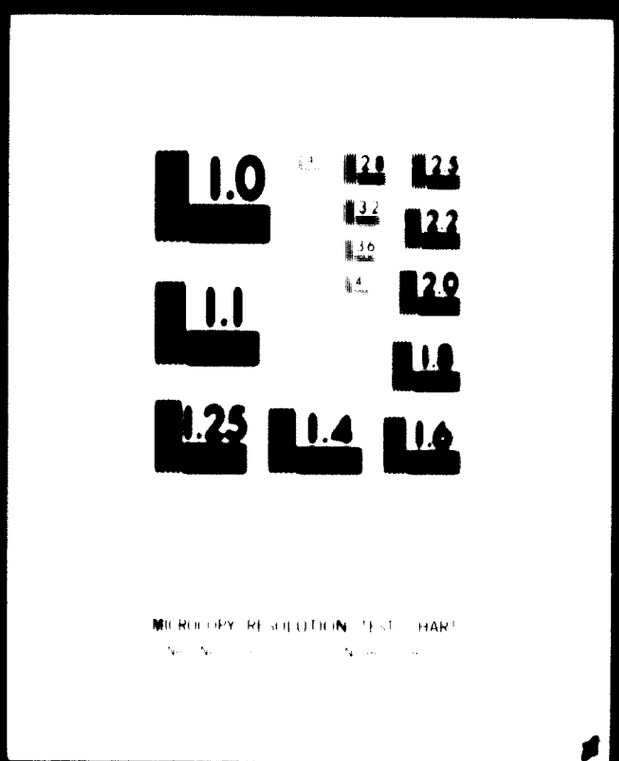

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3 - Classification of steels (cont'd)

Alloy steel

Alloy steels are steels to which significant quantities of alloying elements (other than carbon and the commonly accepted amounts of manganese, silicon, sulphur and phosphorus) are added to improve their mechanical or physical properties. Additions of these alloying elements bring about certain inherent changes in the basic characteristics of steel and render them more suitable for specific uses. For example, additions of nickel or of nickel and chromium together in small percentages to medium carbon steels improve hardenability. The same elements added in large percentages to low carbon steels considerably enhance corrosion and heat resisting properties of the steel. Addition of tungsten to tool steel confers red-hardness properties, that is ability to resist softening of the cutting edge of the tool at the high temperatures generated in the cutting edge during high speed machining operations.

Special steels

Technically all alloy steels are special steels in the sense that they possess properties superior to tonnage steel. There are a few steels which do not contain any special alloying elements, but have properties superior to tonnage steel for specific applications. Examples of such steels are plain carbon forging quality steels used

3 - Classification of steels (cont'd)

for machinery parts, high carbon steels for wire rope, carbon and silico-manganese spring steels, high silicon electrical sheet steels and free cutting steels containing sulphur and phosphorus in higher percentages than normally present in ordinary tonnage steel. In this report the term 'special steels' has been used in the sense referred to above.

Classification of tonnage steels

Tonnage steels are produced in many rolled shapes like bars (rounds, squares, flats, hexagons etc), wire rods, plates, sheets and strip, structural sections (beams, channels, angles, tees etc), and in forged, extruded or drawn condition like axles, tubes, wires etc.

Tonnage steels may be classified by their method of manufacture, as follows:

Classification by process

Open hearth steel	-	i) Acid open hearth ii) Basic open hearth
Bessemer steel	-	i) Acid bessemer ii) Basic bessemer
Crucible steel		
Electrical steel	-	i) Acid electric ii) Basic electric
Basic oxygen steel	-	i) L.D. (also referred to as B.O.F.) ii) Kaldo iii) Rotor iv) LD/AC

Open hearth and B.O.F. steel

Of the above mentioned processes, open hearth at present accounts for the major portion of world steel output though in the near future steel made by basic oxygen process will overtake open hearth production.

Commercial forms of tonnage steel

Steel - outstanding engineering material

Tonnage steel has achieved its predominant position as the best engineering material because it has adequate strength for most constructional and engineering uses, it can be fabricated by virtually any process such as casting, rolling, drawing, forging and extrusion, it is cheaper than any other engineering material offering a similar combination of properties, and it is readily available.

The principal commercial forms are discussed below:

Ingot

Ingot, is a a lid block of steel obtained by casting liquid steel into an iron mould of desired size and shape. Steel is broadly classified into three different types viz killed, semi-killed and rimmed, depending on its oxygen content, the nature and extent of deoxidation of the liquid steel in the finishing stages and its behaviour during solidification.

3 - Classification of steel (cont'd)

Blooms and slabs

The ingots are rolled into the intermediate products blooms and slabs in a primary mill. Blooms are further rolled in different types of rolling mills into smaller size semis called billets and finished rolled products such as medium and heavy structurals, rails and bars. Billets are further rolled in merchant bar mills and rod mills into light sections, bars, rods and wire rods.

Continuous casting

A modern development which has gained rapid acceptance during the last decade is continuous casting of liquid steel directly into billets, blooms and slabs. This process enables major savings in processing time and capital cost by doing away with the conventional ingot casting, stripping, soaking and cogging operations. The principal advantage of the process is lower production cost, resulting from a remarkable improvement (up to 10 per cent) in yield from liquid steel to semis.

Structurals, bars and rods

Structurals can be broadly classified into heavy structurals, medium and light structurals and merchant sections, depending on the size of the rolled product and the type and size of mill in which they are rolled. Heavy structurals are rolled from blooms and light structurals from billets. Heavy rails and bars are

3 - Classification of steel (cont'd)

generally rolled in the same mill in which heavy structurals are rolled. Light rails and bars are rolled in bar mills or medium and light structural mills, small sections and bars and rods are rolled in merchant mills and wire rods are generally rolled in rod mills with continuous finishing stands and coilers.

Flat products

Plates are rolled from slabs in plate mills and hot rolled strips are rolled from slab in semi-continuous or continuous hot strip mill. As strip thinner than 1.5 mm cannot be rolled in hot strip mill, thinner strip and also strip requiring high surface finish are obtained by cold reduction of hot rolled strip in cold strip mill which can be of single stand non-reversing type, single stand reversing type or tandem mill consisting of several stands in series. Before cold reduction, the mill scale formed on hot rolled strip has to be removed by pickling. Annealing and other finishing operations follow cold reduction.

Coated flat products

Among the coated flat products, tinplate and galvanised sheets are the most important. Many other types such as chrome coated, plastic coated and aluminised sheets are finding applications to a limited extent.

3 - Classification of steel (cont'd)

Tinplate

Tinplate may be broadly classified into hot dipped and electrolytic tinplate. Hot dipped tinplate generally carries a heavier coating and is used for applications which require heavy tin coating such as cans for solid food products. In electrolytic tinning, coating weight can be more readily controlled from as low as 0.25 lb/base box to 1 lb/base box.

Galvanised sheets

Galvanising is the process of applying a protective zinc coating to steel. Galvanising of sheets and strips is carried out by the hot dip process. In wire galvanising, electrolytic process is sometimes adopted for special uses. Galvanised sheets are manufactured to several general specifications and the coating weight varies from 0.000920 lbs/sq inch to 0.0038048 lb/sq inch.

Rails, fishplates and sleepers

Rails, sleepers, fishplates, wheels, tyres and axles are the main products in this category. Heavy rails are rolled in same type of mill as structural mill. Light rails and fishplates are rolled in bar mills and medium and light structural mill. Sleepers are made by hot pressing from hot rolled narrow flat products called sleeper bars.

3 - Classification of steel (cont'd)

Wheels, tyres and axles

Wheels and tyres are made by pressing steel blocks of suitable size into roughly formed blanks in a forging press followed by rolling those forged blanks in a wheel and tyre rolling mill. Axles are usually obtained by hammer forging rolled blooms.

Welded pipes

Pipes and tubes can be classified on the basis of method of manufacture into welded and seamless. Large pipes and tubes are made from plates or thick hot rolled strip by fusion welding or electric resistance welding. Medium size and small sized welded tubes are made from hot rolled sheip and strip and also cold rolled strip by pressure buttwelding of heated strip or electric resistance or induction welding of cold strip.

Seamless tubes

Seamless tubes are made by various processes such as push bench, plug rolling, pilgering and continuous rolling in mandrel mill and stretch reducing mill. Hot extrusion process is also used for medium and small sized tubes, particularly for stainless and alloy steel pipes and tubes.

Alloy and special steels

Steels other than tonnage steel can be grouped under alloy and special steels. These steels are often

3 - Classification of steel (cont'd)

made in plants much smaller in size than the large integrated tonnage steel plants, and in which steel making is not integrated with coke and iron making. The steel is usually made in electric arc furnaces with steel scrap as the starting raw material. Alloy and special steels may be broadly classified as discussed below:

High-strength low-alloy structural steels

Small percentages of alloying elements such as nickel, chromium, copper, molybdenum and vanadium together with higher than normal percentages of manganese are added to structural steel to obtain higher tensile and yield strengths and higher yield strength to tensile strength ratio than plain carbon structural steel. Although these steels are alloy steels, they are generally made and rolled in the same plants, by the same processes and into the same shapes as ordinary structural steels, and are also generally used in the as-rolled conditions without any special treatment for the same purposes as ordinary structural steels. Therefore, for all practical purposes they can be classified with tonnage steel.

Constructional steels

Carbon constructional steels

Carbon constructional steels may be of low carbon type for case carburized parts, of medium carbon type forging quality steels for use in machinery parts and

3 - Classification of steel (cont'd)

hand tools and of high carbon type for manufacture of high strength wire rope.

Alloy constructional steels

Alloy constructional steels have greater response to heat treatment than carbon constructional steels and can therefore be hardened and strengthened by heat treatment processes in larger section sizes than carbon constructional steels. The higher the alloy content, the greater is the hardenability, and through-hardening can be obtained with reduced severity of quench and correspondingly reduced risk of warping and cracking. Varying amounts of alloying elements such as manganese, silicon, nickel, chromium, molybdenum and vanadium are used singly or in combination, with the total alloy content varying from 1.5 per cent to 6 per cent depending on the size of the part and the properties required.

Alloy constructional steels, by virtue of their ready response to heat treatment processes, offer a better combination of strength and toughness or strength and wear resistance and are therefore better suited than carbon constructional steels for the manufacture of parts requiring high strength, toughness and wear resistance

such as truck transmission and differential, gears, anti-friction bearings, aircraft engine parts, crank shafts and a host of other machinery parts and components.

Spring steels

This group includes hardenable grades of carbon steels as well as alloy steels used for manufacture of various kinds of springs, such as leaf springs, coil springs, flat and helical springs which have wide applications in transport equipment, machinery and instruments. There are basically three types of spring steels classified on the basis of hardenability characteristics:

Water hardening type
Oil hardening type
Oil/air hardening type

Since the alloying elements have decisive effect on hardenability of steels, they are also classified on the basis of alloy content as follows:

Carbon spring steels
Silico-manganese spring steels
Chrome-vanadium spring steels
Silico-chrome spring steels

Tool and die steels

The term 'tool' can be defined as any part used for shaping materials by such operations as cutting, shearing, forming, drawing, battering etc, and tool steels

3 - Classification of steel (cont'd)

refer to the class or type of steels used in making these tools. Depending on their use, tools must have adequate hardness, wear resistance, strength and toughness to machine, cut or shape materials without themselves being worn out, broken or deformed in the process. Therefore, tool steels have to be of very high quality as regards internal soundness, freedom from defects and metal structure best suited to the manufacture of tools. Very low sulphur and phosphorus contents in the steel are essential. Strict quality control in all the stages of manufacture is therefore necessary to ensure the required quality. Tool steels are sold by brand names and till recently there had been no widely recognised classification based on composition and end-use.

Recently, the American Iron and Steel Institute (AISI) and the Society of Automotive Engineers (SAE) have developed a system for simplifying the classification and selection of tool steels, a system which has found wide acceptability. According to this system, most of the well recognised and extensively used tool steels have been classified under the following heads:

3 - Classification of steel (cont'd)

AISI Designation	Tool steel grade
W1-W7	Water hardening tool steels
S1-S5	Shock-resisting tool steels
O1-O7	Oil-hardening cold work tool steels
A2-A7	Air-hardening medium-alloy cold work tool steels
D1-D7	High-carbon high-chromium cold work tool steels
H11-H16	Chromium hot work tool steels
H20-H26	Tungsten hot work tool steels
H41-H43	Molybdenum hot work tool steels
T1-T15	Tungsten high speed tool steels
M1-M36	Molybdenum high speed tool steels
L1-L7	Low-alloy special purpose tool steels
F1-F3	Carbon-tungsten tool steels
P1-P7	Low-carbon mold steels
6G-6K2	Other alloy tool steels

Each number appended to the letter indicating the designation relates to a specific composition in each grade.

The AISI tool steel classification, as will be evident from the nomenclature, is based not only on composition but also on the type of heat-treatment required as well as end-uses.

Die blocks

Die blocks are used for forging dies. They are made of forged carbon or alloy steel and heat treated to different hardness ranges governed by the size of the die blocks and the design of the forgings for which they

are to be used. Die block steels have generally a carbon content of 0.5 to 0.6 per cent, with or without alloying elements. The alloying elements used are nickel, nickel-chrome, nickel-chrome-molybdenum and nickel-chrome-molybdenum-vanadium.

Stainless and heat resisting steels

Stainless steels, as the name implies, are more resistant to rusting and corrosion than any other type of steel. Perhaps no category of steel has received as much attention as the family of stainless steels which withstand a greater variety of service environments than any other commercial metal. Although stainless steel is relatively a new comer in the metal market, a number of grades have been developed to meet specific service requirements. Stainless steels can be broadly classified into three groups - austenitic, martensitic and ferritic. Austenitic stainless steels contain both nickel and chromium totalling not less than 23 per cent, the minimum content of chromium being 16 per cent and of nickel 7 per cent. The martensitic stainless steels which can be hardened by heat-treatment are primarily straight chromium steels with chromium from 12 per cent to 18 per cent and carbon content varying from 0.15 per cent to 1.20 per cent.

3 - Classification of steel (cont'd)

Ferritic stainless steels are also mostly straight chromium steels with such low carbon content that the steels retain their ferritic structure and cannot be hardened by heat-treatment.

The widely recognised and extensively used specifications for wrought stainless steels are the AISI type No. 300 series for austenitic steels and AISI type No. 400 series for the martensitic as well as for the ferritic steels. High chromium and high chromium-nickel heat resisting steels are also included in these specifications.

Electrical sheet steels

Electrical steel sheets are used for making the cores for motors, dynamos, generators, transformers, etc where high permeability combined with high electrical resistance and low power losses due to eddie currents and hysterisis are required. The sheets required are very thin, 29 G or 26 G, and are made of very low carbon steel with low manganese and sulphur content and silicon content increasing from 0.5 to 4.5 per cent.

Free-cutting steels

Free-cutting steels are used for mass produced machinery and equipment parts which call for high

3 - Classification of steel (cont'd)

production rates, dimensional accuracy and good surface finish. The free-cutting properties are ensured by the addition of comparatively higher percentages of phosphorus and sulphur than normally present in steels, or through lead additions.

Specifications and uses

Typical British, American, German, Japanese, Indian, Russian and Swedish specifications for wrought alloy steels are listed in Appendix 3.2. Specifications, compositions and uses of a comprehensive range of alloy and tool steels are given in Appendix 3.3.

[redacted]

[redacted]

[redacted]

Appendix 1-1

TERMS OF REFERENCE

The Consultant shall make an assessment of steels demand including:

a) special steels
b) alloy and tool steels

in Iran by 1972/1977.

The subject assessment shall include but not necessarily be limited to:

a) Past consumption and present steel demand

Based on available information, the past consumption and the present steel demand shall be reviewed. The general economic conditions of Iran such as population, national income, gross national productivity, industrial capacity etc shall be reviewed based on available information. The requirements of steel and special steels of existing consumers shall be ascertained by types and categories. Attempts shall be made to develop suitable consumption figures for each industry. Based on this information the consumption norms for each industry shall be determined.

b) Raw-age study and future demand

The natural resources and existing industries shall be studied from the view-points of past experiences and future plans. The possibility of new industries based on indigenous and imported raw materials shall be reviewed. The industrial and economic policy of the Government shall be studied to obtain a perspective of the nature and base of economic growth and industrial development visualised for the country for a period of next 10 to 15 years. The fiscal policies and development priorities have to be known. Based on these, a tentative development programme shall be assumed wherein the targets for each sector and corresponding sub-sectors shall be defined. This shall form the basis of the study.

The consumption norms for each industry to the extent possible shall be developed from the available statistics of Iran. In case of new industries to be set up, suitable consumption norms shall be assumed based on past experience. From the assumed development targets and consumption norms the steel requirements shall be ascertained.

c) Correlating the future demand by other methods

The steel demand estimated by the 'end-use approach' shall be checked and correlated with steel consumption in other countries at different time periods and by application of industrial output techniques. Based upon estimates of requirements by various consumers the probable categories of demand shall be determined for a period of say 20 years.

d) Projection of pig iron demand up to 1981

i) Study of probable growth up to 1981 of each of the following major sectors:

- Agriculture
- Transport
- Machinery and equipment manufacture
- Oil drilling
- Mining
- Construction
- Power supply and generation

ii) Impact of import substitution in each of the above sectors.

iii) Projection of the following general economic indicators:

- Population
- National income
- Gross domestic product
- Per capita income
- Industrial production index
- Power generation
- Cement production
- Per capita steel consumption

iv) On the basis of the above, output targets of each steel consuming sector will be assessed. Corresponding steel requirements by types and categories shall then be determined by applying consumption norms, with due consideration to import substitution and structural changes in each sector.

Appendix 1-1 (continued)

v) Checking the future demand: The steel demand estimated above will be checked by other forecasting techniques and shall be correlated with steel consumption in other countries.

c) Identification of candidate projects to fill probable gaps

i) Review of existing production plans.

ii) Assessment of anticipated major shortfall, by types and categories.

iii) Presenting a list of 'candidate projects' with their capacities, etc based upon the probable shortfalls as well as technological considerations of economy of scale and optimum plant size.

iv) Candidate projects will cover the following:

1. Development of infra-structure

- Power
- Transport
- Construction materials
- Utilities

2. Personnel and training requirements.

3. Raw materials development

- Iron ore
- Coal
- Limestone and dolomite

4. Other materials and supplies

- Ferro-alloys
- Refractory
- Chemical plants
- Equipment manufacture, etc.

5. Intermediate and auxiliary industries to consume steel products, such as

- Cold rolling
- Pipe and tube making
- Galvanising and tinning
- Structural fabrication
- Equipment and machinery manufacture
- Iron and steel foundry
- Forging industry
- Tool manufacture

Appendix 1-8

ACKNOWLEDGEMENT

The Consulting Engineers gratefully acknowledge the cooperation and help extended by all agencies and particularly the following in connection with the demand studies on tonnage steel and alloy and special steels.

Iranians

1. UN Experts - Dr A. Nageraja Rao
Dr E.A. Abdelhadj
Mr J. Ramesh
Mr Blair
Mr Hasegawa

2. Ministry of Economy - Dr M. Yeganeh
Dr Mahmoodi
Dr J. Ashrafi
Dr J. Vafa
Mr K. Shirzad
Mr S. Shahoon
Mr Moghaddoli
Mr Gaffari
Mr M. Chafai
Mr C. Khorgi
Dr Sultani
Mr M.H. Mahsoni
Mr A. Sohanaki
Mr S. Rao
Mr Montazar
Mr A. Jairafi
Mr F. Khosrghani
Mr M. Khadi
Dr Ganmadian
Mr E. Moinzadeh

3. Plan Organization - Mr M. Hakimi
Mr Mohsen
Mr Atafi
Mr Vahidi
Mr Sissi

Appendix 1-2 (continued)

Tehran (Cont'd)

4.	Ministry of Water and Power	-	Mr Abdul Fathi
		-	Mr Kutchehpur
			Mr Parvizi
			Mr Ghaemi Moghi
			Mr D. Mariri
			Mr Khadivi
			Mr Pooya
			Mr Moghimi
			Mr F.J. Bollovanco
5.	Industrial Development and Renovation Organization of Iran	-	Mr Khamenei
			Mr R. Khokhar
6.	Arak Machine Building Plant	-	Mr DaCosta
		-	Mr H. Satarwala
7.	Metallurgy and Engineering Company (Tabriz Tractor Plant and Machine Tool Plant)	-	Mr M. Pouliadioun
8.	Iranian Aluminium Company	-	Mr M. Faily
9.	Metallurgical Company of Iran	-	Mr Rosa Zand
10.	National Iranian Steel Company	-	Dr A.A. Sheibani
			Mr K.M. Matar
			Mr Akbari
			Mr Asmlandar
			Mr Valiev
			Dr Dmitriadinov
			Mr Moslov
			Dr J. Mahba
11.	National Iranian Oil Company	-	Mr Farshad
			Mr Shahabadi
			Mr A. Aghayo

Appendix 1-2 (continued)

Iranians (Cont'd)

12.	National Iranian Gas Company	-	Mr M. Shirazi
13.	National Petro Chemical Company	-	Dr Zaheri
14.	Directorate of Small Scale Industries and Industrial Estates	-	Dr Ansari Dr Khosla
15.	Industrial and Mining Development Bank of Iran	-	Mr F. Mahdavi Mr Asgari
16.	Bank Markazi	-	Dr Nemazee Mr Khatami Mr Farhang
17.	Credit Bank	-	Dr K. Iravani
18.	Rezai Brothers	-	Mr Mohammed Rezai Mr Wahid Mr Zaheri

Appendix 3-1

SPECIFICATIONS FOR FOREIGN STEEL PRO...

Indian standard specification	British standard specification	American standard specification	German standard specification	Available forms	Composition C %	Mn %	Si %
Acid							
IS-226/54	-	-	-	-	-	-	-
Gr.I	-	-	-	Billets	0.10/0.16	0.50/0.90	-
Gr.II	-	-	-	"	0.17/0.23	"	-
				"	0.19/0.25	"	-
IS-2062/54	-	-	-	"	0.10/0.17	0.40/1.20	-
				"	0.19/0.30	"	-
Structurals							
IS-226/54	4,15,[illegible]	-	-	Plates, sections, angles, tees, beams, channels, flats, bars and rods	0.25	-	-
IS-1977/52 (St-32)	-	-	-	Plates, sections, angles, tees, beams, channels etc and flats	0.25	-	-
IS-1977/52 (St-44)	-	A201-A285	-	"	0.25	-	-
IS-2062/54	-	-	-	"	0.20	-	-
IS-961/52 (St 55-37)	-	-	-	-	0.27	-	-
IS-2630/54	-	-	-	All types of structural steel	0.21	0.80/1.40	0.35

SECTION 1

Appendix 3-1

Appendix 3-1

TYPES FOR FOREIGN STEEL PRODUCTS

Composition C %	Mn %	Si %	S %	P %	Cu %	Tensile strength kg/mm²	Elongation %	Principal uses
-	-	-	-	-	-	-	-	-
.10/0.16	0.80/1.20	-	0.055	0.055	0.25	-	-	For rivetting into structural steel of standard quality
.17/0.23	"	-	"	"	"	-	-	"
.13/0.25	"	-	"	"	"	-	-	"
.10/0.17	0.40/1.20	-	0.07	0.07	0.07	-	-	} For rivetting into structural steel of ordinary quality
.13/0.20	"	-	"	"	"	-	-	}
.25	-	-	0.055	0.055	0.20/0.35	42/54	23	Mainly for constructional purposes
.25	-	-	0.07	0.07	0.35	52/64	23/28	"
.25	-	-	0.07	0.07	0.35	42/54	23	"
.20	-	-	0.055	0.055	0.20/0.35	42/54	23	For structural purposes where fusion welding property is required
.27	-	-	0.055	0.055	-	50/58	20	Semi-killed or killed quality steel used for high tensile structural purposes
.21	0.60/1.40	0.35	0.05	0.05	-	41/50	22	For ship building purposes

SECTION 2

...dian standard specification	British standard specification	American standard specification	German standard specification	Available forms	Composition C %	Mn %	Si %
...ial products							
...-1002/82	BS-1005	-	-	Plates	-	-	-
Grade I	"	-	1623	"	0.18	-	0.10/0.35
Grade 2A	"	-	-	"	0.080	-	"
Grade 2B	"	-	-	"	0.22	-	"
IRS-...-/59	-	-	-	"	0.20	-	-
IRS-...-/61	-	-	-	"	0.25	-	-
-	BS/4/62	-	-	"	0.20	0.5	-
S-1079/63	BS1449	-	-	Hot rolled sheets/strips	0.18	-	0.06
ST-34	-	-	-	"	0.15	-	0.050
ST-42	-	-	-	"	0.20	-	"
ST-50	-	-	-	"	0.30	-	0.06
ST-52	-	-	-	"	0.22	-	0.05
...2911/63	BS/449	-	-	Cold rolled sheets/strips	0.15	-	-
Ordinary	"	-	-	"	-	-	-
Drawing	"	-	-	"	0.12	-	0.50
Deep drawing	"	-	-	"	0.10	-	0.50
Extra deep drawing	"	-	-	"	0.10	-	0.50
IS-...-/65	BS 1449	-	-	Black plates	0.14	0.60	-
				"	0.10	0.40	-
IRS-...-/65	-	-	-	Sheets	0.15	0.60	-
Pipes and tubes							
-	BS-1387	-	-	Tubes	0.09/0.18	0.30/0.90	0.30 max
IS 1978	BS-3601	A53	-	"	0.20 max	0.70 max	-
-	BS-3602	-	-	Cold drawn seamless tubes and welded tubes and pipes	"	0.40/0.70	-
-	BS-3605	-	-	Seamless tubes	0.20	0.90/1.20	0.10/0.35
IS-3074	BS-980 CDSE	-	-	Tubes	0.20	-	-
IS-3074	BS-980 CEWE	-	-	Welded tubes	0.20	0.60	-
IS-1239	BS-1717 CDSL01	-	1629	Seamless tubes	0.20	-	-

SECTION 1

Appendix 3-1 (continued)

Composition					Tensile strength kg/mm²	Elongation %	Principal uses
Mn %	Si %	S %	P %	Cu %			
-	-	-	-	-	-	-	-
-	0.10/0.35	0.04	0.04	-	55	26	For boiler construction
-	"	0.05	0.05	-	50	25	"
-	"	"	"	-	50	20	"
-	-	0.05	0.05	-	50/47	25	For locomotive boiler construction, non-flowing quality
-	-	0.06	0.06	-	57.9/44.1	24	Flanging and pressing quality for wagons
0.5	-	0.05	0.05	-	-	-	-
-	0.06	0.06	-	-	-	-	For general purposes and forming operations
-	0.060	0.060	-	-	54/42	25	-
-	"	"	-	-	42/50	22	-
-	0.05	0.05	-	-	50/60	20	-
-	0.05	0.05	-	-	52/62	20	-
-	-	0.06	0.06	-	-	-	For ordinary purposes
-	-	-	-	-	-	-	-
-	0.50	0.05	0.05	-	-	-	-
-	0.50	0.04	0.04	-	-	-	-
-	0.50	0.055	0.055	-	-	-	-
0.50	-	0.06	0.09	-	-	-	Black plate for tinning required for deep stamping.
0.40	-	0.05	0.06	-	-	-	For deep drawing quality
0.50	-	0.05	0.04	0.20/0.35	57/45	25	Sheets used for manufacture of internal coach
/0.18 0.30/0.90	0.30 max	0.05	0.05	-			Cold drawn tubes
max 0.70 max	-	0.05	0.05	-			Pipes and tubes for pressure purposes
0.40/0.70	-	0.05	0.05	-			For high duty applications
0.90/1.20	0.10/0.35	0.05	0.05	-			For application at low temperature
-	-	0.05	0.05	-			For automobiles
0.60	-	0.05	0.05	-			"
-	-	0.05	0.05	-			Cold drawn seamless tubes used for cycles and motor cycles.

SECTION 2

Indian standard specification	British standard specification	American standard specification	German standard specification	Available forms	Comp C %	Mn %	Si %
Bars and rods							
IS-2073/6							
C-20	-	-	-	Carbon steel bars	0.15/0.25	0.60/0.90	0.05/0.
C-40	-	-	-	"	0.35/0.45	0.60/0.90	"
IRS-M-4/65	-	-	-	Steel bars	0.18	0.70	-
IRS-M-27/54	-	-	-	"	0.25	-	-
IS-1148/64	-	-	-	"	0.20	-	-
IS-1149/64	-	-	-	"	0.22	-	-
IS-1139/59	-	-	-	Deformed bars	0.20	-	-
"	-	-	-	"	0.30	-	-
Wires							
IS-432/66	BS-549	-	-	Bars and wires	0.25	-	-
	BS-970/55	-	-	Bars	0.07/0.15	0.80/1.20	0.10 m
IS-2879/64	-	-	-	Wires	0.09	0.40/0.60	0.03
Railway materials							
IRS-T-12/60							
1) Mod. Mn	BS-9	-	-	Rails	0.50/0.60	0.95/1.25	0.07/0
2) Plain carbon	BS-11	-	-	"	0.55/0.69	0.65/0.90	0.05/
IRS-T-18/62							
1) Mod. Mn	-	-	-	"	0.40/0.60	0.90/1.45	0.03/
2) Plain carbon	-	-	-	"	0.50/0.70	0.60/0.95	0.03/
IRS-T1/57	BS-47	-	-	Fish plates	0.30/0.35	0.90 max	0.15 m
IRS-R19/59	-	ASTM A-57	-	Wheels	0.57/0.77	0.96 max	0.60/
IRS-M4/65 class IV	-	A329	-	Tyres	0.52/0.62	0.5/0.9	0.15/
IRS-R16/65	-	A21/A393	-	Axles	0.45/0.55	.60/.90	0.15 m

SECTION 1

Composition C %	Mn %	Si %	S % max	P % max	Cu %	Tensile strength kg/mm²	Elongation %	Principal uses
0.15/0.25	0.60/0.90	0.05/0.35	0.06	0.06	-	44/52	23	For production of machined parts
0.35/0.45	0.60/0.90	"	"	"	-	59/69	22	for general engineering purposes
0.18	0.70	-	0.06	0.06	-	39/44	25/32	For general engineering purposes
0.25	-	-	"	"	0.25	47/55	27/32	For manufacturing high tensile rivets
0.20	-	-	"	"	0.35	39/51	35	For manufacturing rivets for structural purposes
0.22	-	-	"	"	0.20/0.35	47	31	For manufacturing high tensile rivets for structural purposes
0.20	-	-	0.06	0.065	-	42.5/53.5	20/24	Deformed bars for use in constructional purposes
0.30	-	-	0.05	0.06	-	59.5/67.5	18/22	Manufacture of medium tensile deformed bars for constructional purposes
0.25	-	-	0.055	0.055	-	42	23	For use as concrete reinforcement bars
0.07/0.15	0.80/1.20	0.10 max	0.20/0.30	0.07	-	-	-	For forging purposes
0.09	0.40/0.60	0.05	0.025	0.028	0.15	-	-	For manufacture of metal arc welding electrode core wire
0.50/0.60	0.95/1.25	0.07/0.20	0.06	0.06	-	72	14	Railroad rails - medium duty purpose
0.55/0.69	0.65/0.90	0.05/0.30	0.06	0.05	-	72	12	"
0.40/0.60	0.90/1.15	0.05/0.30	0.06	0.06	-	-	-	"
0.50/0.70	0.60/0.95	0.05/0.30	0.06	0.06	-	-	-	Railroad rails for heavy duty purpose
0.30/0.35	0.90 max	0.15 max	0.06	0.06	-	57/66	20	Fishplates for all kinds of rails
0.57/0.77	0.96 max	0.60/0.95	0.06	0.06	-	66.1/77.2	-	For manufacture of wrought steel for railway carriages and wagons
0.52/0.62	0.5/0.9	0.15/0.35	0.05	0.05	-	66.1/77.2	-	For wheel tyres of railway carriages and wagons
0.45/0.55	.60/.90	0.15 min	0.05	0.05	-	.55.1/8.5	-	Axles for railway carriages and wagons

SECTION 2

Composition					Tensile strength kg/mm²	Elongation %	Principal uses
Mn %	Si %	S % max	P % max	Cu %			
0.60/0.90	0.05/0.35	0.06	0.06	-	44/52	29	For production of machined parts for general engineering purposes
0.60/0.90	"	"	"	-	50/60	22	
0.70	-	0.05	0.06	-	39/44	25/30	For general engineering purposes
-	-	"	"	0.25	42/55	27/30	For manufacturing high tensile rivets
-	-	"	"	0.35	39/51	35	For manufacturing rivets for structural purposes
-	-	"	"	0.20/0.35	47	31	For manufacturing high tensile rivets for structural purposes
-	-	0.06	0.065	-	42.5/55.5	20/24	Deformed bars for use in constructional purposes
-	-	0.06	0.06	-	50.8/67.5	14/20	Manufacture of medium tensile deformed bars for constructional purposes
-	-	0.055	0.055	-	42	23	For use as concrete reinforcement bars
0.80/1.20	0.10 max	0.20/0.30	0.07	-	-	-	For forging purposes
0.40/0.60	0.05	0.025	0.025	0.15	-	-	For manufacture of metal arc welding electrode core wire
0.95/1.25	0.07/0.20	0.06	0.06	-	72	14	Railroad rails - medium duty purpose
0.65/0.90	0.05/0.30	0.06	0.06	-	72	12	"
0.90/1.15	0.05/0.30	0.06	0.06	-	-	-	"
0.60/0.95	0.05/0.30	0.06	0.06	-	-	-	Railroad rails for heavy duty purpose
0.90 max	0.15 max	0.06	0.06	-	57/66	20	Fishplates for all kinds of rails
0.96 max	0.60/0.95	0.05	0.05	-	66.1/77.2	-	For manufacture of wrought steel for railway carriages and wagons
0.5/0.9	0.15/0.35	0.05	0.05	-	66.1/77.2	-	For wheel tyres of railway carriages and wagons
.60/.90	0.15 min	0.05	0.05	-	55.1/63.5	-	Axles for railway carriages and wagons

Appendix 3-2

VARIOUS STANDARD SPECIFICATIONS FOR [illegible]

Countries	UK	USA	GERMANY	
Specification Designation	BS	AISI	Werkstoff Nr	DIN/WNBL
Type and grade of steels				
A. Alloy constructional steels				
0.08% Carbon chromium steel	970 En 11	-	1.9181	59 Cr V 4
Manganese-nickel-molybdenum steel	970 En 13	-	-	-
Carbon-manganese steel	970 En 14 A and B	1021	-	-
Carbon-manganese steel	970 En 15	1034 1036 1340	1.5066	36 Mn 5
Manganese-molybdenum steel	970 En 16	-	-	-
1% chromium steel	970 En 18	5140	1.7035	41 Cr 4
1% chromium molybdenum steel	970 En 19	4135 4140 4145	1.7220 1.7225	34CrMo4 42CrMo4
Nickel-chromium steel	970 En 23	-	1.5736	31NiCr14
1½% Nickel-chromium-molybdenum steel	970 En 24	4340	1.6562	34CrNi1
4% Nickel-chromium steel (with or without Mo)	970 En 30 A and B	-	1.5864	35Ni Cr19
1% carbon-chromium steel	970 En 31	52100	1.3505	100 Cr 6 [illegible]105Cr
Low alloy steel	970 En 100	9840 9845	1.6511	36CrNiMo 4
Low nickel-chromium-molybdenum steel	970 En 110	-	1.6582	34CrNiMo 6
Low nickel-chromium steel	970 En 111	3135 3140	1.5710	36 NiCr 6
B. Case-hardening carbon and alloy steels				
Carbon case hardening steel	970 En 32 A, B and C	1010 1012 1015	1.0301 1.0401	C 10 C 15
2% nickel-molybdenum (Ni-Mo) steel	970 En 34	4615 4617 4620	-	-

SECTION 1

SPECIFICATIONS FOR WROUGHT AND CAST STEELS

[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
Werkstoff Nr	DIN/VDEh	JIS	[illegible] to 1970	[illegible]	SIS [illegible] 14
1.9161	50 Cr V 4	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
1.5066	20 Mn 5	-	37 Mn 5	-	21 90
-	-	-	35 Mn 5 Mo 45	-	-
1.7035	41 Cr 4	G 4101 SCr 4	40 Cr 1 Cm(X) 40CM(***)	4540-40	21 28
1.7220 1.7223	34CrMo4 [illegible]Cr[illegible]Mo4	G 4105 SCM3 SCM4 SCM5	35CrMo 28 35Cm(***) 35CM[illegible](***)	4543-	21 34
1.5736	31[illegible]Cr14	G 4102 SUS2	-	-	23 34
1.6582	34Cr[illegible]4	G 4106 SNCM1	40 Ni 2	-	2[illegible] 41
1.5984	30Ni Cr10	-	-	-	25 38
1.3505	100 Cr 6 I:45[illegible],100Cr2	-	105 Cr 1	-	-
1.6511	36Cr[illegible]Mo 4	G 4106 SNCM3 SNCM7			-
1.6582	34Cr[illegible]Mo 6	-	-	-	-
1.5710	36 [illegible]Cr 6	G 4102 SUC1	35 [illegible]Cr60	4543-[illegible] -[illegible]	[illegible] 20
1.0501 1.0401	C 10 C 15	-	C 10, C 14	-	1350
-	-	-	20 Ni 2 Mo 25	-	25 20

SECTION 2

Countries	UK	USA	GERMANY	
Specification designation	BS	AISI	Werkstoff Nr	DIN/VDEW
Type and grade of steels				
B. Case-hardening carbon and alloy steels (Cont'd)				
3% Ni-Cr and Ni-Cr-Mo case hardening steel	970 En 36 A and B	-	1.5752	14 NiCr 14
4½% Ni-Cr and Ni-Cr-Mo case hardening steel	970 En 39 A and B	-	1.5860	14 NiCr 18
1½% Ni-Cr-Mo case hardening steel	970 En 325	4320	-	-
¾% Ni-Cr case hardening steel	970 En 351	-	-	-
1% Ni-Cr case hardening steel	970 En 352	-	-	-
1¼% Ni-Cr case hardening steel	970 En 353	-	-	-
1½% Ni-Cr case hardening steel	970 En 354	-	-	-
'15' carbon low alloy case hardening steel	970 En 361	9315	-	-
'20' carbon low alloy case hardening steel	970 En 362	9720	-	-
'25' carbon low alloy case hardening steel	970 En 363	9822 9825	-	-
C. Nitriding steels				
1½% Cr-Al-Mo nitriding steel	970 En 41A	-	-	-
1½% Cr-Al-Mo nitriding steel	970 En 41B	-	-	-
D. Spring steels				
Silicon-manganese spring steel (oil hardening)	970 En 45 45A and 24 part 3A Gr 1 and 2 part 3 B	9255 9260	1.0904 1.0909	55 Si 7 -
Silicon-manganese spring steel	970 En 45 and 24 part 3A Gr 3 and 4	-	1.0900	53 Si 6
1% CrV spring steel (oil hardening)	970 En 47	6150	1.8159	50 CrV 4
1% Cr Spring steel	970 En 48	5147	1.7086	41 Cr 4
Cr-V steel for valve spring	970 En 50	-	1.7861	4° Cr V6

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1.8782	14 WCr 14	-	13 W18 Cr4V	-	21 14
1.8980	14 WCr 19	G 4108 WCV 25	-	-	-
-	-	G 4108 WCV 25	-	-	-
-	-	-	18 W18Cr4V	-	-
-	-	-	-	-	-
-	-	-	18 WCr1 Mo18	-	22 11
-	-	-	18 W18Cr1 Mo18	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	21 40
-	-	-	40Cr2 11Mo18	Smith(X) W104	-
1.0904	55 91 7	G 4901-5076	55 91 Mn 30	2082-55 33(?)	20 20
1.0909	-	G 4901-5077		2082-55 33(?)	
1.0900	51 91 6	-	57 91 Mn 30	-	-
1.9189	50 CrV 4	-	50 Cr1 V 23	2082-Smith(?X)	22 40
1.7088	41 Cr 4	G 4104-50r4	50 Cr 1	55 33-55 Cr 991(?X)	-
1.7861	4? Cr W	-	-	-	-

Countries	UK	USA	GERMANY	
Specification designation	BS	AISI	Werkstoff	DIN/VDEh
In Tool steels				
Carbon tool steel	Steels for Cold working D1	W 1	1.1550	-
	"	W 1	1.1550	-
	"	W 1	1.1550	-
	"	W 1	1.1545	-
	"	W 1	1.1550	-
	Steels for Cold working D1 and steels for chisels A1	W 1	1.1520	-
	Steels for cold working D1	W 1	1.1740	-
		W 2	1.2552	100 V1
High speed steel	High speed steels (a) 18% W	T 1	1.3355	S18-0-1 (B19)[2]
	(b) 8% Co	T 4	1.3255	S18-1-2-5 (E19 Co5)
	(b) 10% Co	T 5	1.3265	S18-1-2-10 (E19 Co10)
	-	M 2	1.3343	S6-5-2 (D Mo 5)
Alloy tool steels	-	W5, W5	1.2002	125 Cr1
			1.2210	115 Cr V3
			1.2208	140 Cr V1
		L1	1.2067	100 Cr6(W5)
			1.2080	105 Cr6
	-	O1, O2	-	-
	-	-	1.2740	28 W1 Cr Mo V 10
	-	M1	1.2343	X30 Cr Mo V31

SECTION 1

	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
	Werkstoff	DIN/VDEL	AISI	[illegible]	[illegible]	[illegible]
	1.1660	-	G 4401 SM1	* 133	G 13	-
	1.1650	-	G 4401 SM2	* 119	G 12	1995
	1.1650	-	G 4401 SM3	* 108	G 10	1990
	1.1640	-	G 4401 SM4	* 90	-	1970
	1.1650	-	G 4401 SM5	* 90	G 9	1780
	1.1650	-	G 4401 SM6	* 70	G 9	1780
	1.1740	-	G 4401 SM7	* 60	G 7	-
	1.2433	100 V1	G 4404 SM315	* 108 V28	*	-
	1.2436	S18-0-1 (D19)[2]	G 4408 SM[illegible]	* 70 W19 Cr4 V1	9373-R19 ~19M	2750
	1.2436	S18-1-2-5 (E19 Co5)	G 4408 SM[illegible]	* 78 W 19 Co5 Cr4 V1 Mo75	937[illegible]-R19KE P2	2784
	1.2436	S18-1-2-10 (E19 Co10)	G 4408 SM44A	* 78 W 19 Co 10 Cr 4 V2 Mo75	-	2765
	1.2343	S6-5-2 (D Mo 5)	G 4408 SM[illegible]	* 65 Mo W5 Cr4 V2	-	-
W5	1.2002 1.2210 1.2206	125 Cr1 115 Cr V3 140 Cr V1	G 4404 SK99	* 119 Cr45 * 113 Cr45	8260-Ch(Y) 35	-
	1.2067 1.2080	100 Cr6(W5) 105 Cr6	G 4406 SW1 SW2	* 105 Cr1	8260-0 Ch (Y)	
02	-	-	-	* 105 Cr Mn90	8260-0 Ch(W(=3Y)	-
	1.2760	99 W1 Cr Mo V 10	G 4410 SKC22 SKC25	* 31 W18 Cr65 Mo55	-	-
	1.2363	X30 Cr Mo V51	G 4404 SKD6	* 35 Cr5 Mo1 V30	-	-

SECTION 2

Countries	UK	USA	GERMANY	
Specification designation	BS	AISI	Werkstoff Nr	DIN/VDEH
Type and grade of steels				
E. Tool steels (Cont'd)				
Alloy steels	-	H12	1.2606	X37 Cr Mo W51
	-	D2	1.2201	X165 Cr V12
	-	D3	1.2080	X210 Cr12
	-	M21	1.2581	X30 W Cr V 93
F. Stainless and heat resisting steels [1]				
Austenitic type				
17/7 Stainless	-	301	1.4310	X12 Cr Ni 17-7
18/8 Stainless	970 En 58 A and B	302	1.4300	X12 Cr Ni 18-8
18/8 Stainless (high Si)	-	302 B	1.4320	-
Free cutting Stainless	-	303	1.4305	X12 Cr Ni S 18-9
19/10 Stainless	970 En 58E	304	-	-
19/10 Stainless (very low carbon)	-	304L	1.4306	X2 Cr Ni 18-9
Cr-Ni-Mo	970 En 58H	316	1.4401	X5 Cr Ni Mo 18-10
Ti stabilised	58C	321	1.4541	X10 Cr Ni Ti 18-9
Cb stabilised	-	347	1.4550	X10 Cr Ni Nb 18-9
Heat resisting	-	309	1.4828	X15 Cr Ni Si 20-12
Ferritic type				
13 Chromium	-	405	1.4002	X7 Cr Al 13
16 Chromium	970 En 60	430	1.4016	X8 Cr 17
25 Chromium	-	446	-	-
Martensitic type				
13 Chromium	970 En 56 A and B		1.4006	X10 Cr13
13 Chromium - free cutting	-	416	1.4119	X15 Cr Mo 13
13 Chromium - Med carbon	970 En 56D	420	1.4034	X40 Cr13

SECTION 1

GERMANY		JAPAN	INDIA	USSR	SWEDEN
Werkstoff Nr	DIN/VDEL	JIS	IS No 1570	GOST	SIS No 14
1.2606	X37 Cr Mo V51	-	T 35 Cr5 Mo V1 V30	5960-4X5C	-
1.2201	X165 Cr V12	G 4404 SKD11	T 160 Cr12	-	-
1.2080	X210 Cr12	G 4404 SKD1	T 215 Cr12	5950 x 12	-
1.2581	X30 W Cr V 93	-	T 35 W9 Cr3 V 39	-	-
1.4310	X12 Cr Ni 17-7	SUS 30	-	-	-
1.4300	X12 Cr Ni 18-9	SUS 40	07 Cr18 Ni9	-	-
1.4330	-	-	-	-	-
1.4305	X12 Cr Ni S 18-9	-	-	-	-
-	-	SUS 27	04 Cr19 Ni9	-	-
1.4306	X2 Cr Ni 18-9	SUS 29	-	-	-
1.4401	X5 Cr Ni Mo 18-10	SUS 32	06 Cr19 Ni11 Mo3	-	-
1.4541	X10 Cr Ni Ti 18-9	SUS 29	04 Cr19 Ni9 Ti20	-	-
1.4550	X10 Cr Ni Nb 18-9	SUS 43	04 Cr19 Ni9 Cb40	-	-
1.4828	X15 Cr Ni Si 20-12	G 4312 SUH 32	-	-	-
1.4002	X7 Cr Al 18	SUS 38	07 Cr18	-	-
1.4016	X8 Cr 17	SUS 24	07 Cr17	-	-
-	-	G 4312 SUH6	-	-	-
1.4006	X10 Cr18	SUS 31	15 Cr18	-	-
1.4119	X15 Cr Mo 18	-	-	-	-
1.4034	X40 Cr18	SUS 32 SUS 33	30 Cr18	-	-

Countries	UK	USA	GERMANY	
Specification designation	BS	AISI	Werkstoff Nr	DIN/VDEL
Type and grade of steels				
E. Tool steels (Cont'd)				
Martensitic type				
16 Chromium 2 Nickel	970 En 57	431	1.4057	X22 Cr-Ni17
1 Chrome high carbon	-	440	-	-
AO. Carbon constructional steel	970 En 3, 3A and 3C	1020	1.0402	C22
	970 En 3, 3K	1030	-	-
	970 En 8A	1035	1.0501	C35
	970 En 8, 8K	1040	1.5069	40 Mn 4
		1045	1.0503	C45
	970 En 9, 9K	1055	-	-

a/ DIN designations in parenthesis are the old ones non superseded
b/ In case of stainless and heat resisting steels, AISI and SAE are shown separately

SECTION 1

GERMANY		JAPAN	INDIA	USSR	SWEDEN
Werkstoff Nr	DIN/VDEL	JIS	IS No 1570	GOST	STS No 14
1.1057	X22 Cr-N117	-	-	-	-
-	-	-	-	-	-
1.0402	C22	G 4051-S22C	C-20	1050-20	1460
-	-	G 4051-S25C S-30C	C-30	1050-30	-
1.0501	C35	G 4051-S35C S35C	C-35	1050-35	1550
1.5058	40 Mn 4	G 4051-S40C	C-40	1050-40	-
1.0503	C45	G 4051-S45C	C-45	1050-45	1650
-	-	G 4051-S55C	C-55 Mn75	1050-55	-

nown separately

SECTION 2

ALLOY AND TOOL STEELS : SPECIFICATIONS

Class of steel	Equivalent specifications AISI	BS 970:1955	IS:1570-1961	Chemical composition - % main alloying C	Mn	Si	Ni	Cr	V
A. Tool steels									
1. Carbon tool steels									
Plain carbon	W1	-	T 60 to T 133	0.60/1.40	-	-	-	-	-
Carbon - Vanadium	W2	-	T80V23 to T103V23	0.60/1.40	-	-	-	-	0.25
Carbon-chrome-vanadium	W1	-	T118Cr45 to T133Cr45	0.60/1.40	-	-	-	0.50	0.20
2. Cold work - low alloy									
Carbon - tungsten	F1	-	-	1.00	-	-	-	-	-
Carbon - tungsten	F2	-	T140Cr60	1.25	-	-	-	-	-
Manganese	O2	-	-	0.90	1.60	-	-	-	-
Manganese-chrome-tungsten-vanadium	O1	-	T90Mn2W50 Cr45	0.90	1.00	-	-	0.50	0.15 (opt)
3. Cold work - high alloy									
Air-hardening medium-alloy	A2	-	-	1.00	1.00	-	-	5.00	0.40 (opt)

L STEELS : SPECIFICATIONS AND USES

sition % / main alloying elements %						Special characteristics	Typical uses
W	Mn	Cr	V	Ni	Co		
-	-	-	-	-	-	Shallow water hardening. In sections over 12 mm dia gives hard case with strong tough resilient core.	Cold heading, striking, coining and embossing dies, wood working tools, hand metal cutting tools such as chisels, taps, reamers and files, hot and cold sets, shear blades, mining drill steel, smith tools, hammers, swages, flatteners, wear resistant parts for machine tool uses, and cutlery.
-	-	0.25	-	-	-	Same as above, but tougher	
-	0.50	0.80	-	-	-	Deeper hardening than above	
-	-	-	1.25	-	-	Shallow hardening, high wear resistance. Water hardening.	Threading taps, hacksaw blades.
-	-	-	3.00	-	-	Shallow hardening, very high wear resistance.	Paper cutting knives, wire drawing dies, plug gauges, forming tools and brass working tools.
-	-	-	-	-	-	Oil hardening. Less distortion and less hazard of cracking than in the case of water hardening steels.	Short run cold-forming dies, blanking dies, gauges and cutting tools where no high temperatures are generated.
-	0.80	0.15 (opt)	0.80	-	-		
-	5.00	0.60 (opt)	-	4.00	-	Minimum risk of distortion with air-hardening	Long run forming and blanking dies, gauges, abrasion resistant liners, trimming shears for light gauge material

SECTION 2

Steels	Equivalent specifications			Chemical composition - % main alloying						
	AISI	BS 970:1955	IS:1570-1961	C	Mn b/	Si b/	Ni	Cr	V	W
A. Tool steels (cont'd)										
Hi-carbon-Hi-chromium	D1	-	-	1.00	-	-	-	12.00	0.50 (opt)	-
"	D2	-	T1600Cr12	1.50	-	-	-	12.00	0.50 (opt)	-
"	D4	-	T2150Cr12	2.25	-	-	-	12.00	0.50 (opt)	-
4. Hot work										
Chrome-tungsten-molybdenum-vanadium	H12	-	T350Cr5Mo WV50	0.35	-	-	-	5.00	0.40	1.
Chrome-tungsten	H14	-	-	0.40	-	-	-	5.00	-	5.
Chrome-tungsten	H16	-	-	0.55	-	-	-	7.00	-	7.
Tungsten-chrome	H21	-	T350Cr6V50	0.35	-	-	-	3.50	0.40 (opt)	9.
"	H24	-	-	0.45	-	-	-	3.00	-	15.
"	H26	-	-	0.50	-	-	-	4.00	1.00	18.
5. Shock resisting										
Silicon-molybdenum	S2	-	-	0.50	-	1.00	-	-	-	
Manganese-silicon-molybdenum	S5	-	-	0.50	0.80	2.00	-	-	-	
Chrome-tungsten-vanadium	S1	-	T60WCr1V12	0.45	-	-	-	1.50	0.20	2.

SECTION 1

Composition - % main alloying elements[b]							Special characteristics	Typical uses
[b]	Ni	Cr	V	W	Mo	Co		
-	-	12.00	0.50 (opt)	-	1.00 (opt)	-	Low dimensional change in hardening. Highly wear resistant, wear resistance increasing with carbon content.	Long run forming and blanking dies, gauges, abrasion resistant liners, trimming shears for light gauge material.
-	-	12.00	0.50 (opt)	-	1.00	-		
-	-	12.00	0.50 (opt)	-	1.00 (opt)			
-	-	5.00	0.40	1.50	1.50	-	Deep hardening. Can be air hardened in large sections. Low distortion in hardening.	Hot work dies of all types such as extrusion, die-casting and forging dies, mandrels, hot shears, hot heading tools and upset dies.
-	-	5.00	-	5.00	-	-		
-	-	7.00	-	7.00	-	-		
-	-	5.30	0.40 (opt)	9.00	-	-	Increasing resistance to high temperatures softening and washing with increasing alloy content	Mandrels and extrusion dies for high temperature applications, and forging dies of rugged construction. (Dies need to be preheated to operating temperature before use).
-	-	5.00	-	15.00	-	-		
-	-	4.00	1.00	18.00	-	-		
.00	-	-	-	-	0.50	-	Water or oil hardening. Hardness combined with strength and toughness.	Pneumatic cutting and battering tools like chisels, rivet busters, rivet sets, beading and caulking tools, concrete breakers, stamps, punches collets, knockout pins, wrenches, rotary shear blades, cold shear blades.
.00	-	-	-	-	0.40	-		
-	-	1.50	0.20	2.00	-	-		

SECTION 2

Class of steel	Equivalent specifications AISI	BS 970:1955	BS 1570-1961	Chemical composition - % main alloying C	Mn	Si	Ni	Cr	V
A. Tool steels (cont'd)									
6. High speed (tungsten) 18W:4Cr:1V	T1	-	T70W18Cr4V1	0.70	-	-	-	4.00	1.00
18W:4Cr:2V	T2	-	-	0.80	-	-	-	4.00	2.00
18W:4Cr:1V:5Co	T4	-	T83W18Co5Cr4V1Mo75	0.75	-	-	-	4.00	1.00
18W:4Cr:2V:10Co	T5	-	T75W18Co10Cr4V2Mo75	0.80	-	-	-	4.00	2.00
12W:4Cr:4V:5Co	T15	-	T123W14Co5Cr4V4	1.25	-	-	-	4.00	4.00
High speed (tungsten-molybdenum)[W] 6.5W:5Mo:1.5Cr:4Cr:1V	M1	-	-	0.80	-	-	-	4.00	1.00
6.0W:5.0Mo:4.25Cr:4Cr:2V	M2	-	T85W6Mo5Cr4V2	0.85	-	-	-	4.00	2.00
7. Chromium Chrome-vanadium	L2	-	-	0.50/1.10[X]	-	-	-	1.00	0.20 (opt)
Ni-Cr-Mo	L6	-	-	0.70	-	-	1.50	0.75	-

SECTION 1

Composition - % main alloying elements						Special characteristics	Typical uses
W	Cr	V	Mo	Co			
-	4.00	1.00	18.00	-	-	High red hardness (resistance to permanent softening at temperatures up to 600°C) and high wear resistance.	Practically all metal cutting tools such as single point tools, tool bits, twist drills, reamers, taps, broaches, milling cutters and hobs.
-	4.00	2.00	18.00	-	-	Greater wear resistance than T1.	Broaches, reamers, milling cutters and hobs.
-	4.00	1.00	18.00	-	5.00	Greater red hardness than T1	Heavy duty cutting tools, particularly for rubbing cuts.
-	4.00	2.00	18.00	-	8.00	Greater wear resistance and red hardness than T1 or T4	Heavy duty cutting tools.
-	4.00	4.00	12.00	-	5.00	Exceptional wear resistance.	Tool bits and form cutters.
-	4.00	1.00	1.50	8.50	-	Substitute high speed steels extensively used in USA.	Long slender tools like twist drills, reamers, taps, broaches. All metal cutting tools.
-	4.00	2.00	6.25	5.00	-	These steels are more sensitive to heating and hardening conditions than W base steels.	
-	1.00	0.20 (opt)	-	-	-	Water or oil hardening.	Combine hardenability and wear resistance with toughness. Useful for machine tool applications such as bearings, rollers, clutch plates, high wear springs, feed fingers and chuck parts.
1.50	0.75	-	-	0.25 (opt)	-	Oil hardening.	

Class of steel	Equivalent specifications SAE	BS.970:1955	IS:1570-1961	Chemical composition - % main alloying ele C	Mn	Si	Ni	Cr	V
B. Constructional steels									
1. Plain carbon									
Low-carbon	1020	En 3	C 20	0.20	0.80	-	-	-	-
Medium-carbon	1030	En 5	C 30	0.30	0.80	-	-	-	-
Medium-carbon	1040	En 8	C 40	0.40	0.80	-	-	-	-
High-carbon	1055	En 9	C 55 Mn 70	0.55	0.70	-	-	-	-
High-carbon	-	-	C 70	0.70	0.65	-	-	-	-
2. Low alloy - medium tensile									
Manganese	1330	En 14B	27Mn2	0.30	1.70	-	-	-	-
Manganese-molybdenum	-	En 16	35Mn2Mo28	0.35	1.60	-	-	-	-
Chromium	5132	-	-	0.32	0.80	-	-	1.00	-
Chromium	5137	En 18	40Cr1	0.37	0.80	-	-	1.00	-
Nickel-chromium	3140	-	35Ni1Cr60	0.40	0.80	-	1.80	0.60	-
3. Medium alloy-high tensile									
Chrome-molybdenum	4140	En 19	40Cr1Mo28	0.40	0.65	-	-	1.10	-
Nickel-chrome-molybdenum	4340	En 24	40Ni2Cr1Mo28	0.40	0.55	-	1.80	1.10	-
"	-	En 25	31Ni3Cr65Mo55	0.31	0.33	-	2.50	0.65	-
"	-	En 26	40Ni3Cr65Mo55	0.40	0.55	-	2.30	0.65	-
"	-	En 30B	-	0.30	0.30	-	4.10	1.25	-

SECTION 1

% main alloying elements				Special characteristics	Typical uses
Ni	Cr	V	Mo		
-	-	-	-	Tensile strength - 40 kg/mm^2	For general purpose uses as bars and forged parts.
-	-	-	-	-do- - 50 "	-do-
-	-	-	-	-do- - 60 "	Shafts, axles, railroad components.
-	-	-	-	-do- - 70 "	Gears, heavy duty machinery parts, leaf springs.
-	-	-	-	-do- - 140/220 "	Patented cold drawn wire for high duty wire ropes and ACSR core wire.
-	-	-	-	Water or oil hardened and tempered.	Automotive axles, steering parts, high strength bolts, machinery axles, shafts.
-	-	-	0.20	Tensile strength:65-85 kg/mm^2 Elong. E = 5d - 10 to 12%.	
-	1.00	-	-		
-	1.00	-	-		
1.80	0.60	-	-		
-	1.10	-	0.20	Oil hardened and tempered.	Aircraft, truck and other heavy duty machinery parts, ordnance materials.
1.80	1.10	-	0.20	Tensile strength: 90-110 kg/mm^2	
2.50	0.65	-	0.55	Elong. E = 5d - 10 to 12%.	
2.30	0.65	-	0.55		
4.10	1.25	-	0.25	Oil or air hardening. Tensile strength: 120 kg/mm^2 Elong. E = 5d - 9%	Aircraft & heavy duty machinery parts, particularly those of large size requiring high strength, intricately designed parts requiring air hardening.

SECTION 2

Class of steel	Equivalent specifications SAE	BS 970:1955	ISA 370-1961	Chemical composition - % main alloying C	Mn	Si	Ni	Cr
B. Constructional steels (cont'd)								
4. Case hardening								
Manganese	-	-	20Mn	0.20	1.50	-	-	-
Manganese-molybdenum	4023	-	-	0.23	0.80	-	-	-
Chromium molybdenum	4118	-	-	0.18	0.80	-	-	0.50
Nickel-molybdenum	4615	En 34	-	0.15	0.60	-	1.80	-
"	4620	En 34	-	0.20	0.60	-	1.80	-
Chromium	5115	-	-	0.15	0.80	-	-	0.80
"	5120	-	-	0.20	0.80	-	-	0.90
Chromium-vanadium	6118	-	-	0.18	0.60	-	-	0.60
"	6120	-	-	0.20	0.80	-	-	0.80
Nickel-chrome-molybdenum	8620	En 361	-	0.20	0.80	-	0.60	0.60
"	-	-	16NiCr2Mo20	0.16	0.60	-	2.00	1.60
Nickel-chromium	3315	En 39A	-	0.15	0.50	-	3.5	1.60
Nickel-molybdenum	4615) 4620)	-	-	0.18	0.50	-	3.5	-
Nickel-chrome-molybdenum	9315	En 39B	-	0.15	0.50	-	3.8	1.50
5. Nitriding								
Chromium-aluminium	-	-	-	0.35	0.60	-	-	1.60
Chromium-molybdenum-aluminium	-	En 41B	40CrMoAl8	0.40	0.60	-	-	1.60
Chromium-molybdenum-vanadium	-	En 40C	40CrMoV20	0.40	0.60	-	-	3.00

SECTION 1

ition - % main alloying elements[a]								Special characteristics	Typical uses
Ni	Mn	Cr	T	Mo					
-	-	-	-	-				Carburised, heat treated parts	Cam shaft, wrist pin, clutch finger of automotives, wear resisting machinery parts.
-	-	-	-	0.25				Core tensile strength - 50-55 kg/mm^2.	
-	-	0.30	-	0.15					
-	1.80	-	-	0.25				Carburised, heat treated parts.	Gears, pinions, universal joints, piston pins, wear resisting machinery parts requiring greater core strength.
-	1.80	-	-	0.25				Core strength: 70-75 kg/mm^2	
-	-	0.20	-	-					
-	-	0.90	-	-					
-	-	0.60	0.15	-					
-	-	0.80	0.10	-					
-	0.60	0.60	-	0.20					
-	2.00	1.60	-	0.20				Carburised, heat treated parts, Core strength: 70-75 kg/mm^2	Gears, pinions, wear resisting machinery parts having good core strength.
-	3.3	1.60	-	-				Core strength: 120 kg/mm^2	Aircraft equipment and truck transmission, differential and other very heavy duty parts.
-	3.5	-	-	0.25				"	
-	3.8	1.50	-	0.15				"	
						Tensile strength		Case hardness RC	
-	-	1.60	-	-	Al	1.0	70 kg/mm^2	66	Spindles, measuring tools.
-	-	1.60	-	0.20	Al	1.0	80 "	66	Wear resistant parts for use at 450°C or over, such as for steam turbine.
-	-	3.00	0.20	1.00			80 "	62	Valve spindles, crank shafts.

Class of steel	Equivalent specifications SAE	BS 970:1955	IS:1570-1961	Chemical composition - % main alloyi C	Mn	Si	Ni	Cr
B. Constructional steels (cont'd)								
6. Ball bearing								
Chromium	5.100	En 31	103Cr1	1.05	0.30	-	-	1.05
Chromium	52100	En 31	103Cr1	1.05	0.30	-	-	1.45
7. Spring steels								
Medium carbon	-	En 43	-	0.45/0.60	0.70	-	-	-
High carbon	-	En 42	230Mn65	0.80	0.65	-	-	-
High-carbon	-	En 44	-	1.05	0.60	-	-	-
Silico-manganese	9255	En 45	55Si2Mn90	0.55	0.90	1.80	-	-
Chromium	5130	En 48	500r1	0.30	0.80	-	-	1.10
Chrome-vanadium	6150	En 47	300r1V25	0.50	0.70	-	-	1.00
Silico-chrome	-	En 48A	-	0.55	0.70	1.30	-	0.70
8. Die block								
Plain carbon	-	BS224/1	-	0.55	0.75	-	-	-
Nickel	-	BS224/2	-	0.55	0.65	-	1.25	-
Nickel-chrome	-	BS224/3	-	0.55	0.65	-	1.50	0.65
Nickel-chrome-molybdenum	-	BS224/4	-	0.35	0.60	-	0.90	0.95
Nickel-chrome-molybdenum-vanadium	-	BS224/5	-	0.50	0.55	-	0.95	0.95

SECTION 1

Composition - % main alloying elements a/						Special characteristics	Typical uses
	Si	Mn	Cr	V	Mo		
)	-	-	1.05	-	-	Very high degree of cleanliness i.e. freedom from non-metallic inclusions.	Antifriction bearing balls, rollers, races.
	-	-	1.45	-	-	-do-	-do- of large size.
)	-	-	-	-	-	Water hardening.	Leaf and volute springs.
5	-	-	-	-	-	Water/oil hardening	Leaf and coil springs
0	-	-	-	-	-	-do-	"
0	1.8)	-	-	-	-	Oil hardening	Leaf, helical, volute and plate springs.
0	-	-	1.10	-	-	"	"
0	-	-	1.00	0.20	-	"	Leaf springs for heavy duty vehicles, helical, flat and conical coil springs.
0	1.50	-	0.70	-	-	"	Heavy duty helical springs, valve spring.
5	-	-	-	-	-	Used in normalised condition.	Composition, treatment, hardness range will depend on die block size, production run, machining sequence and cost.
5	-	1.25	-	-	-	Used in normalised or heat treated condition	
5	-	1.50	0.65	-	-	Used in heat treated i.e. hardened and tempered condition. Die sinking may be before or after treatment.	
0	-	0.90	0.95	-	0.55		
5	-	0.95	0.95	0.05	0.55		

SECTION 2

Class of steel	Equivalent specifications SAE	BS 970:1955	IS:1570-1961	Chemical composition - % main alloy C	Mn	Si	Ni	Cr
C. Stainless steels								
1. Austenitic type								
18 chrome - 9 nickel	302	En 58B	07Cr19Ni9	0.15 max	2.00 max	1.00 max	9.00	18.0
Free-cutting stainless	303	-	-	0.15 max	2.00 max	1.00 max (with 0.15/0.25% sulphur)	9.00	18.0
19 chrome-9 nickel	304	En 58E	04Cr19Ni9	0.08 max	2.00 max	1.00 max	9.00	19.0
Very low carbon	304L	-	-	0.03 max	2.00 max	1.00 max	9.00	19.0
Chrome-nickel-molybdenum	316	-	06Cr[illegible]17Ni12Mo2	0.10	2.00	1.00	12.00	17.0

SECTION 1

on - % main alloying elements ✓ Ni	Cr	V	Mn	Special characteristics	Typical uses
) 9.00	18.00	-	-	Has to be quenched from 1050°C - 1100°C to obtain the soft corrosion resistant austenitic condition.	Food processing, dairy and kitchen equipment, sanitary ware, architectural uses and light-weight structures.
) 9.00	18.00	-	-	Has to be quenched from 1050°C -1100°C to obtain the soft corrosion resistant austenitic condition.	Free machining type for bolts, nuts, screws, studs and cold heading.
5/0.25% sulphur)					
) 9.00	19.00	-	-	"	Equipment for chemical and paper industry. More amenable to welding than type 302, but still susceptible to inter-granular corrosion.
) 9.00	19.00	-	-	"	The very low carbon content renders the steel virtually immune to inter-granular corrosion after welding or stress relieving. Used for welded parts subject to corrosive atmosphere and also for high temperature service under corrosive conditions.
00 12.00	17.00	-	2.50	"	Has the maximum corrosion resistance of all stainless steels in highly ionised reducing acids. Can be used at elevated temperatures and for handling liquids in paper, chemical, petroleum and other processing industries.

SECTION 2

Class of steel	Equivalent specifications SAE	BS 970/1955	IS:1570-1961	Chemical composition - % main alloying C	Mn	Si	Ni	Cr	V
C. Stainless steels (cont'd)									
1. Austenitic type (cont'd) Titanium-stabilised	321	-	040r19Ni9Ti80	0.08	2.00	1.00	10.00	18.00	Ti-
Columbium-stabilised	347	-	040r19Ni9Nb40	0.08 max	2.00 max	1.00 max	10.00	18.00	
Nickel-free	-	-	-	0.12	14.00	1.00	-	21.00	
2. Heat resisting High chromium nickel	309	-	-	0.20 max	2.00 max	1.00 max	13.00	25.00	
3. Magnetic iron 13 chromium	405	-	070r13	0.08	1.00	1.00	-	13.0	

SECTION 1

Main alloying elements %				Special characteristics	Typical uses
C	Cr	Ti	Nb		
0.30	18.00	Ti-6xC	-	Has to be quenched from 1050°C-1100°C to obtain the soft corrosion resistant austenitic condition.	Virtually free from intergranular attack in corrosive media after welding or stress relieving at temperatures up to 820°C. For same uses as type 304, and also for high temperature service principally in and around aircraft engines and for steam power service.
10.00	19.00		- 8x-10x	"	"
-	21.00		- 0.60 N	"	Can serve as a substitute for AISI types 302 and 304 for such uses as domestic appliances, household utensils, railway and auto fittings, sanitary ware, food processing and dairy equipment etc.
15.00	25.00	-	-	Has to be quenched from 1050°C-1100°C to obtain the soft corrosion resistant austenitic condition.	Heat resistant steel suitable for uses such as boiler baffles, fire box parts, industrial furnace equipment, heat exchangers kiln and oven lining.
-	18.0	0.80	-	Low carbon and the small amount of Al help retain the steel in ferritic condition.	Heat resistant parts for use at temperature up to 700°C. For lining oil refinery vessels and mining equipment for corrosion resistance against highly aggressive media.

SECTION 2

Class of steel	Equivalent specifications SAS	BS.970:1955	IS:1570-1961	Chemical composition - % main alloying C	Mn	Si	Ni	Cr
C. Stainless steels (cont'd)								
3. Ferritic type (cont'd) 16 chromium	430	En 60	07Cr17	0.12 max	1.00 max	1.00 max	-	16.00
4. Heat resisting 25 chromium	446	-	-	0.20 max	1.00 max	1.00 max	-	25.00
5. Valve steels Silicon-chrome	35Si-8Cr	En 52	40Cr9Si4	0.45	0.40	3.50	-	8.5
Silicon-chrome-nickel	251200r-Ni	En 59	90Cr20Si2Ni1	0.80	0.40	2.00	1.50	20.00
Chrome-nickel-tungsten	14Cr14Ni-2W	En 55	40Cr14Ni14 W3Si2	0.40	0.70	1.50	14.00	14.00
6. Martensitic type 13 chromium	410	En 56B	15Cr13	0.15 max	1.00 max	1.00 max	-	12.5
13 chromium free-cutting	416	-	-	0.15 max	1.25 max	1.00 max	-	13.0

% main alloying elements a/ Ni	Cr	V	Mo	Special characteristics	Typical uses
-	16.00	-	-	Takes on and retains a bright polish. Can be deep drawn to some extent.	Extensively used for automotive and architectural trim and other decorative uses. Heat-resistant parts for use at temperature up to 800°C, heat exchangers for handling nitric acid and also for some kitchen utensils.
-	25.00	NO. 25 Max	-	High scaling resistance.	Furnace and recuperator parts, thermocouple sheath etc for use at temperature up to 1050°C, heat exchangers, pyrolysis plant tubes.
-	8.5	-	-	Ferritic alloy	For heavy duty inlet and light duty exhaust valves.
1.50	20.00	-	-	Ferritic alloy	"
1.00	14.00	14.00	W 2.60	Austenitic alloy	For heavy duty exhaust valves and for parts required to have high strength at high temperatures.
-	12.5	-	-	Used in both annealed as well as hardened and tempered condition.	Valve steams, pump linings, oil refinery bubble trays, bubble caps and liners.
-	13.0	S 0.15/ 0.25	-	Used in heat-treated condition.	Corrosion resistant high strength fittings, bolts, nuts and machined parts.

SECTION 2

Class of steel	Equivalent specifications SAS	BS 970-1955	IS:1570-1961	Chemical composition - % main alloying C	Mn	Si	Ni	Cr
C. Stainless steels (cont'd)								
6. **Martensitic type** (cont'd) 13 chromium medium carbon	420	En 56D	30Cr13	0.30/ 0.40	1.00 max	1.00 max	-	13.0
13 chromium high carbon	-	-	-	0.70	1.00 max	1.00 max	-	13.0
16 chrome-2 nickel	431	En 57	-	0.20 max	1.00 max	1.00 max	2.00	16.00
17 chrome - high carbon	440A	-	-	0.70 max	1.00 max	1.00 max	-	17.00
"	440B	-	-	0.85	1.00 max	1.00 max	-	17.00
"	440C	-	-	1.10	1.00 max	1.00 max	-	17.00

a/ Percentages indicated are the medium of the range
b/ Present in normal percentages where not specifically mentioned.
c/ Various carbon contents are available in 0.10% ranges up to 1.00% carbon, and in 0.15% ranges above extra (Grade 1), Standard (Grade 3) and Commercial Grade 4).
d/ In U.S.A, which produces the greater part of the world's supply of ferro-molybdenum nearly 85% of all use would depend on the relative prices of ferro-molybdenum and ferro-tungsten which fluctuate gre
e/ Available with various carbon contents in the 0.10% range.

SECTION 1

n - % main alloying elements				Special characteristics	Typical uses
Ni	Cr	V	Mo		
0 -	15.0	-	-	For parts requiring higher hardness and strength than AISI type 410	Cutlery, valve parts, corrosion resistant ball bearings.
0 -	13.0	-	-	-	Stainless steel safety razor blades
0 2.00	16.00	-	-	Has higher corrosion resistance and about the same strength as the nickel free martensite steels.	High strength corrosion resistant shafting, machinery parts.
0 -	17.00	-	0.75	Steels of increasing carbon content and hardenability.	Sharp edged cutlery and surgical instruments, dental tools, corrosion resistant ball bearings, bushings and valve parts.
0 -	17.00	-	0.75		
0 -	17.00	-	0.75		

).15% ranges above 1% carbon. Carbon tool steels are supplied in four grades: Special (Grade 1),

nearly 85% of all high speed steels used are Mo-base high speed steels. In other countries, their which fluctuate greatly.

SECTION 2

REPORT

TO

THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

ON

ASSESSMENT OF STEELS DEMAND IN IRAN

FOR

THE MINISTRY OF ECONOMY, IMPERIAL GOVERNMENT OF IRAN

VOLUME II

DECEMBER 1970

M. N. DASTUR & COMPANY PRIVATE LTD. CALCUTTA

LAHMEYER INTERNATIONAL GmbH DUSSELDORF

02093
(2 of 4)

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APPENDICES IN VOLUME II

EXPLANATION OF SYMBOLS

Three dots (...) indicate that data are not available or are not separately reported.

A dash (-) indicates that the amount is nil or negligible.

A blank space ( ) in a table means that the item is not applicable.

A plus sign (+) indicates a surplus or an increase.

A minus sign (-) indicates a deficit or decrease.

A space between numerals is used to distinguish thousands and millions (1 256 000).

A full stop (.) is used to indicate decimals.

A stroke (/) indicates a crop year or fiscal years, e.g. 1963/1964

Use of a hyphen (-) between dates representing years, e.g. 1962-64 normally signifies an annual average for the calendar years involved, including the beginning and end years. 'to' between the years indicates the full period, e.g. 1960 to 1964 means 1960 to 1964, inclusive.

Reference to 'tons' indicates metric tons, and to 'dollars' United States dollars, unless otherwise stated.

Details and percentages in tables do not necessarily add up to totals, because of rounding.

1 - [redacted]

Iran has entered a new era of sustained economic growth under the impetus of the developmental plans. The Third Plan stressed the development of small and medium-scale industries. The Fourth Plan is the first stage of the long term programme to industrialise the country, the main objective of which is to make Iran self-sufficient to the optimum extent in capital and consumer goods and to diversify the export of locally manufactured goods.

Growth in these directions will inevitably mean a corresponding increase in the rate of steel consumption in the country.

[redacted]

[redacted]

Indigenous production and imports

The apparent consumption of steel in a country can be inferred from the amount of steel produced indigenously plus steel imports less exports neglecting the variations in stocks. In the case of Iran, so far there has not been any indigenous primary steel production. The entire requirements of the country have hitherto been met through imports.

4 - Past consumption and present demand for steels (cont'd)

both direct imports as finished and semi-finished steel products and indirect imports in the form of machinery, equipment and consumer durables. Since there has hardly been any steel export (except for some negligible quantity of pipes exported to Pakistan and Saudi Arabia in the past two years), the apparent consumption can be taken as the quantity of steel imported. If to this are added the indirect imports in the form of machinery and other manufactured goods, the total would represent the gross consumption.

Steel Imports

Direct Imports

The import statistics for iron and steel products, finished or semi-finished, for the years 1962 to 1966 are given in Appendix 4-1 and a summary of the various categories of steels imported is presented in Table 4-1. Items such as iron castings, pig iron for these iron castings and scrap have not been included in Table 4-1. As the iron for castings is different from iron for steel making, and is generally made in a separate furnace, these cannot be considered for the purpose of projecting the future aggregate demand. Similarly, steel castings have also been excluded in Table 4-1 due to the fact that the steel for steel castings is made by the foundries themselves.

Table 4-4

[redacted] STEEL [redacted] - 1982 TO 1988

[redacted]		[redacted]		[redacted]		[redacted]		[redacted]
A. [redacted]								
Angle	..	0.07	0.15	0.18	0.01	0.20	0.01	0.22
Structurals	..	120.70	40.01	160.02	48.12	120.70	39.00	154.04
Bars and rods	..	57.04	7.01	64.05	10.02	66.03	0.16	67.20
Wire	..	17.07	4.01	21.07	4.07	19.00	3.04	27.04
Rails and railway materials	..	0.07	0.01	0.08	1.03	0.04	0.17	1.16
Steel pipes, tubes and fittings	..	70.03	20.01	90.03	15.01	100.00	24.00	174.17
Flat products	..	97.03	25.15	74.18	30.03	111.70	22.03	154.01
Special steels	..	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
		367.23	100.00	533.00	100.00	615.07	100.00	804.04
B. [redacted] ✓	..	[redacted]	-	[redacted]	-	[redacted]	-	[redacted]
Total consumption		[redacted]	-	[redacted]	-	[redacted]	-	[redacted]

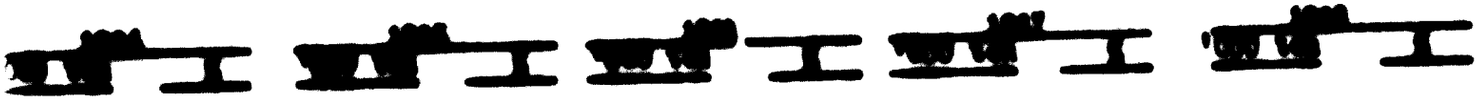
✓ Indirect figures have been estimated from the groupwise import statistics (tonnage and value) of appropriate terms. This does not include plant and machinery imported under package deals.

[redacted] SECTION 1 [redacted]

Table 4-1

STEEL [illegible] - 1912 TO 1959

Table 4-1



0.39	0.08	0.88	0.04	0.88	0.89	3.88	0.85	8.65	0.65
190.78	39.89	884.84	37.18	885.14	40.18	382.88	89.81	335.88	84.46
48.89	8.86	67.88	8.82	89.85	12.48	82.87	7.89	48.88	8.88
18.48	8.84	87.88	4.84	87.78	8.88	48.48	8.89	82.88	8.86
0.84	0.17	1.88	0.87	7.88	1.81	17.81	1.47	88.18	8.88
188.88	84.89	874.87	88.44	888.88	14.89	878.88	88.88	418.88	88.48
111.78	88.88	884.88	88.88	888.48	88.88	878.88	88.78	887.88	88.18
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
888.87	188.88	884.84	188.88	788.81	188.88	1 888.88	188.88	1 888.88	188.88
[illegible]	-	[illegible]	-	[illegible]	-	[illegible]	-	[illegible]	-
[illegible]	-	[illegible]	-	[illegible]	-	[illegible]	-	[illegible]	-

ation (tonnage and value) of engineering items involving steel, on the basis of ...ted timber package basis.

4 - Past consumption and present demand for steels (cont'd)

Import statistics

The official import statistics of Iron, though comprehensive, are generally trade oriented and do not give adequate technical data for detailed categorywise assessment of steel consumption. For instance, in the case of flat products separate figures are not available for plates, strips and cold rolled products. In the case of special steels, the types of steels included under this general nomenclature are not clearly indicated.

Indirect imports

Besides direct imports of steel products, a great deal of steel is imported in the form of manufactured items such as machinery, machine parts and components, fabricated items like steel structures, tanks and vessels, automobiles and other transport equipment, domestic appliances, engineering goods etc. The steel content of these items forms a part of the country's real steel consumption though it will not be reflected in the country's steel demand till such time as these items are produced indigenously. Since the main objective of the programme of rapid industrialisation is to achieve self-sufficiency, indigenous production at the earliest opportunity of as many steel-consuming capital and consumer goods as possible, is necessarily implied. It is

4 - Past consumption and present demand for steels (cont'd)

therefore important to know also the tonnage of steel indirectly imported in the form of engineering goods, so that the country's total steel requirements could be assessed and adequate provision made in the plans for timely supplies of steel as and when indigenous manufacture of these items are taken up.

Steel content of imported items

A fair estimate of the quantity of steel involved in indirect imports can be had from the import statistics of steel consuming items collected for the past few years. For this purpose, import data on various items of machinery and components were collected for the years 1958 to 1960 from the foreign trade statistics and classified under the major steel consuming groups such as transport equipment, industrial machinery, electrical machinery etc. Appropriate steel content norms for each group on the basis of tonnages and or values of imports were applied to arrive at the steel content of the imported machinery and components. These estimates of the quantity of steel imported indirectly in the form of manufactured goods are given in Table 4a1 along with data on direct imports of steel. Details of the quantities and values of the relevant imported items entering into indirect imports of steel are given in Appendix 4a2.

4 - Past consumption and present demand for steels (cont'd)

Since hardly any steel item has been re-exported, the direct and indirect imports taken together may be assumed as presenting a reasonably accurate picture of the gross steel consumption in the country.

Exclusions in import statistics

However, it should be noted that the foreign trade statistics do not include plant and machinery imported under 'package deals' for complete supply of plants, for instance the Heavy Machine Building Plant at Ranchi, the Machine Tool Plant at Pinjore and the Steel Plant at Bokaro. Also excluded are imports for defence purposes. Consequently, the real consumption figure would be still higher if the steel content of machinery and equipment imported under package deals (not included in the import statistics) were to be taken into account.

[redacted]

Trends

The imports of steel scrap, according to published import statistics, have increased from 600 tons in 1956 to only 8,000 tons in 1958, indicating installation of some steel re-rolling facilities in the country during the period. The import figure for 1958 however is not seen to be correctly presented as billets amounting to Rourkela Rolling Mills Company which was commissioned in July 1959, are not shown in the import statistics. It is expected

that these are included in some other category. With more finishing mill capacity being created in Iran, the import of semis would continue to rise till such time as indigenous steelmaking capacity goes into production which may not be earlier than 1973. Iranian Rolling Mills Company alone would be requiring over 150,000 tons of billets every year as both of its rolling mills have already gone into regular production.

Imports of steel structurals have risen from 100,000 tons in 1962 to 200,000 tons in 1967 registering an increase of more than 100 per cent during the five year period. But their share in the total imports has come down from 40 per cent to about 30 per cent, due to even larger increases in the overall imports of other categories of steel. In 1968 however, imports of structurals jumped to 300,000 tons due mainly to indigenous production of some types of structurals and restrictions placed on imports of such items.

Building construction is the largest single consumer of steel structurals in the form of beams, channels and angles. Typical Iranian building designs are based on steel frame construction and the steel consumption in different types of buildings is about

4 - Past consumption and present demand for steels (cont'd)

86 kg per sq m on an average. Of the total import of 388,000 tons of structurals in 1967, beams alone account for 224,000 tons, while channels and angles amount to 19,000 tons and 47,000 tons. More than 100,000 tons of beams were imported from West Germany which was the biggest single exporter to Iran, accounting for 27 per cent of Iran's steel imports. UK, Japan, Italy, France and India accounted for about 10 per cent each and the rest shared by several other countries including USA, USSR and East European countries.

With the commencement of indigenous production of angles and tees in sizes 20 mm to 80 mm, import restrictions have been placed on the imports of these sizes of products. This trend is likely to continue and imports of structurals of different sizes would decrease to the extent they are made locally. Building construction practices are also rapidly changing in Iran as there is a gradual switch over from structural steel frame to reinforced concrete. The weight of steel consumption per unit area of building will therefore decrease gradually. This would also imply that there will be significant decrease in the requirement of structurals in future.

4 - Past consumption and present demand for steels (cont'd)

Bars and rods

Import of bars and rods has registered a rise of more than 300 per cent during the period 1963 to 1967 increasing from 37,000 tons to 92,000 tons. In 1968, however, imports dropped to 49,000 tons mainly as a result of indigenous production of 65,000 tons from Ahwaz Rolling Mills combined with import restrictions on these products to protect the local industry. In 1967 India was the largest supplier of reinforcing bars, accounting for 21,615 tons out of a total of 24,201 tons. Since indigenous capacity for these bars has now gone into production and further capacity is being installed, imports of reinforcing bars including ribbed bars may diminish substantially. However, as the Iranian building industry is gradually moving round to reinforced concrete construction, it is reasonable to expect that the overall demand for bars in the country would rise in future, which would be met in increasing measure by indigenous production.

[illegible]

There has been a steep increase in imports of flat products from 67,000 tons in 1963 to 200,000 tons in 1968. The share of flat products in total steel imports has risen from around 20 to 25 per cent to about 30 per cent, but even this is much below the consumption percentage in developed countries. Sheeted plates and sheets alone

4 - Past consumption and present demand for steels (cont'd)

have risen from 80,000 tons to 320,000 tons. The main uses are for cold formed profiles, structural fabrication, automobile body building, steel furniture and manufacture of various domestic appliances. Import statistics do not report separately the tonnage of cold rolled sheets, but it is estimated to be 45 to 50 per cent of the total imports of flat products. The welded pipe plant at Ahwaz is now one of the largest consumers of heavy plates. The oil consortium refinery at Abadan uses about 35,000 tons of cold rolled strip for drum manufacture.

Barring a cold strip mill based on imported hot rolled strips, there are no other immediate plans to manufacture flat products locally. Therefore the imports of flat products would continue to rise, though there may be changes in the type and finish of the products imported. At present UK supplies about 20 per cent of Iran's cold rolled sheet and 35 per cent of hot rolled sheet requirements. Other leading suppliers are Japan and West Germany.

Imports of tinplate has risen from 10,000 tons in 1958 to 21,000 tons in 1963, an increase of more than 200 per cent in six years. West Germany has been the biggest supplier, accounting for 12,000 tons out of 21,000 in 1963. UK, France, Japan and USA are the other

4 - Past consumption and present demand for steels (cont'd)

main suppliers. Tinplates are used mostly by can and container manufacturers. The import figures reported include also prefabricated tin cans which are finished locally.

Pipes and fittings

As Iran is a major oil producing country, steel pipes and fittings are of special significance in the country's pattern of steel consumption. An increase from 78,000 tons to 416,000 tons in the last six years is striking and indicates the rapid progress in the field of oil production and refining as well as water supply. The proportion of tubes and pipes in total steel consumption has been around 25 per cent, which is typical of oil producing countries compared to less than 10 per cent for other countries. Small diameter pipes from 12 to 76 mm are mostly used for water and gas, while large diameter pipes are used by the oil and gas industries. Imports from Japan alone amounted to 130,000 tons in 1967 and imports in 1968 exceeded 150,000 tons in the first six months. Italy, West Germany and France have been the other major suppliers.

A major portion of the pipes imported in 1967 and 1968 was utilized for IGAT Project, the consumption being 80,000 and 107,000 tons in 1967 and 1968 respectively.

4 - Past consumption and present demand for steels (cont'd)

In general, the pattern of steel consumption in Iran in the past has been very closely related to the country's economic and industrial activities.

Steel import trade

With a long history of steel imports, steel import trade had considerable influence on Iran's economy. Most of the big consumers like the oil companies, automobile manufacturers, can and container manufacturers, and some of the small industrial units import steel directly for their use without going to established importers and stockists. Nevertheless, there is a well-established steel import trade in the country. Many importers regularly import and stock various steel products to cater to the needs of retail traders, builders, contractors etc. A list of established importers of iron and steel products is given in Appendix 4.8. The list does not include consumer industries and other agencies who import steel directly to meet their own manufacturing and processing requirements.

Import trade

The majority of the steel importers are small trading houses. Both in their past trade are not readily available with them. There was also some reluctance to disclose the trade figures. The recent changes in Iran's

4 - Past consumption and present demand for steels (cont'd)

import policy (namely the ban on imports of rounds, bars and light structurals which are produced locally and increase in import duty on beams and channels and some other categories of steel) have affected the steel import trade adversely.

Direct imports

Interviews with steel importers revealed that the bulk of the steel imports are directly by the users for their own consumption. Imports through the trade account only for about 20 to 25 per cent of the total. Of this, about 70 per cent is light and heavy structurals and medium sections, and the rest flat products, pipes, tubes and fittings. The main customers are small traders, building contractors, fabricators, small manufacturing units etc. Only ordinary tonnage steel is imported by the trade, and except for bright shaftings in a few cases, alloy or special steels are not handled by the trade. The stock level with the importers at any given time varies from a few hundred tons to few thousand tons largely depending on the issues and expected arrivals of new consignments. As a consequence, availability is tight in the steel market and steel prices keep fluctuating widely, depending on the availability and demand for a particular category of steel.

4 - Post consumption and present demand for steels (cont'd)

Imported steel [redacted]

The increase in world prices of steel in early 1969 of about $ 30 to 40 per ton together with the rise in import duty has made imported steel expensive. The price of steel in Iran almost doubled in 1969. Steel billets selling at 13 to 15 Rials per kg in January were being sold at 22 to 26 Rials per kg in August 1969.

Alloy steels consumption

Direct imports of alloy steels by the consumer mainly include constructional steels for manufacturing industries like automobiles, tool steels for paper blade and hacksaw blades, stainless steel sheets for cooking ranges etc and spring steels mainly used in automobile manufacture.

Direct imports of alloy [redacted]

The import statistics of alloy steels from 1968 to 1969 given in appendix and are summarized below:

Year		Imports of alloy [redacted]
[redacted]	..	[redacted]
[redacted]	..	[redacted]
[redacted]	..	[redacted]
[redacted]	..	[redacted]
[redacted]	..	[redacted]
[redacted]	..	[redacted]
[redacted]	..	[redacted]

4 - Past consumption and present demand for steels (cont'd)

Unaccounted increase in demand

The types and qualities of steels imported under this classification are not clearly indicated. Prior to 1956 imports of alloy and special steels were less than a thousand tons per year. In 1956 about 3,000 tons of special steels were imported. The statistics show a sudden upward in alloy and special steels imports from 3,000 tons in 1956 to about 20,000 tons in 1957 and to 33,000 tons in 1958. There have been no structural changes in Iran's economy which would warrant this sudden increase in demand for alloy steels and no satisfactory explanation was available for this jump. A closer examination of imports under this head, however, reveals that about 30,000 tons of imports during the year 1958 are accounted for by 6,000 tons of steel wire and about 24,000 tons of cold rolled sheets. The c.i.f. values of these steels indicate that these items are not alloy and special steels. It would appear that steel wire and sheets imported for cold drawing industry, drawable qualities and sheet industries (additional capacities for which have been created during the period), have been erroneously shown as alloy and special steels.

Thus, the actual import figures pertaining to alloy and special steels in the import statistics are around 9,000 tons in 1958 comprising mostly alloy constructional

4 - Post consumption and present demand for steels (cont'd)

tool, die, stainless and other special steels but excluding spring steels and carbon constructional steel which have been classified in the official statistics as ordinary steel.

The annual imports of spring steel for the manufacture of automobile springs are in about 4,000 tons. Imports of carbon constructional steel is estimated to be around 4,000 tons in 1968. Thus, direct imports into Iran of alloy and special steels (including spring steels and carbon constructional steel) amounted to about 14,000 tons in 1968. The figures also appear to be confirmed by the results of field survey.

The following is an estimated breakdown by types of alloy and special steel including spring steel and carbon constructional steel imported in 1968.

Alloy constructional steels	..	[illegible] tons
Tool and die steels	..	[illegible] tons
Stainless and other steels	..	[illegible] tons
Spring steel	..	[illegible] tons
Carbon constructional steel	..	[illegible] tons
Total	..	[illegible] tons

About 60 per cent of the total alloy and special steels is imported directly by the consumers, and the rest is imported by the following dealers, who are mostly local selling agents of alloy steel producers abroad.

[redacted]

[redacted]	[redacted]	[redacted]
a. [redacted]	[redacted]	[redacted]
b. [redacted]	[redacted]	[redacted]
c. [redacted]	[redacted]	[redacted]
[redacted]		[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

4. Post-completion and present projects for steels (cont'd)

[illegible]

The average annual growth rate observed in per cent during the Third Plan period implies the growth of consumption, which was possible mainly due to the low starting base. It is anticipated that growth rate during the Fourth Plan will be about 10 per cent, making the last years of the Third Plan as the base period. The Fourth Plan projects the anticipated for several major public sector projects, namely:

i) Integrated steel plant at Bokaro with an initial capacity of 1.0 mn. of finished steel per year to be expanded to 4.0 million tons subsequently in future.

ii) Heavy Electrical Plant at Hardwar with 40,000 tons capacity per year.

iii) Heavy Rail Plant at Durgapur, with a capacity of 60,000 tons per year.

iv) Fertilizer plant projects - [illegible] complex for producing 380,000 tons per year each of ammonia and sulphate, the Korba complex for producing polyvinyl chloride (30,000 tons per year), isopropanol (10,000 tons per year), and caustic soda (24,000 tons per year); and the Namrup complex for producing 180,000 tons per year of sulphur and 2,000,000 barrels per year of liquid petroleum gas.

v) Aluminium smelting project in Korba, with an annual capacity of 40,000 tons

vi) Tractor factory at Pinjore with an annual capacity of 10,000 tractors. In the initial stage 5,000 tractors will be manufactured and 5,000 assembled. In the final stage 10,000 tractors will be manufactured.

4. [illegible]

[illegible] the [illegible] several industrial units manufacturing products of significance to be implemented in the private sector also. These industries include [illegible] cables, telephone and wireless apparatus, [illegible] equipments, pipes, [illegible] etc.

[illegible]

The steel consumption pattern broadly [illegible] closely relatable to the development trends of steel consuming industries. It is necessary to have a clear picture of consumption pattern, in order to make meaningful projections for the future.

The principal steel consuming sectors are

i) transport equipment
ii) electrical equipment
iii) industrial and agricultural machinery
iv) metal products
v) construction and allied activities

Transport equipment

In the transport equipment sector, only the automobile industry is well developed at present in India. Other items such as wagons, tractors, rail coaches, aeroplanes etc. are not manufactured at present. Consequently, steel consumption by the automobile industry accounts for practically the entire steel consumption of this sector.

[redacted]

4. Steel consumption and product [redacted] (cont'd)

Electrical machinery

[redacted] electrical equipment sector is mainly a mixture of assembly and manufacturing activities. Most existing units are small, with a bias towards electrical appliances. There are five firms whose small tonnage steel requirements are satisfied by merchant bars, sheets, strips, and plates. Steel consumption in this sector is estimated at [redacted] tons in 1980.

Industrial and agricultural machinery

The processing technology and product types of [redacted] machinery are being modernized at present. This sector is the least developed in the hill country. In the North Plan greater attention is being paid to machine building and heavy machines, metallurgical plant and equipment, air compressors, industrial boilers, agricultural machinery, cranes and so on. The steel consumption by this sector is estimated at [redacted] tons in 1980.

Metal products

Metal products manufacture is a major steel consuming sector. In this sector, steel furniture, gas cylinders, stoves, drums and containers, electrodes, pipes and tubes and profiles are the principal consuming items which account for about 95 per cent of total steel consumption by this sector.

[illegible]

Final consumption for 'entertainment and allied activities' appears in the output inventory. Under this sector are included entertainment activities in the following fields:

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

[illegible]

As mentioned earlier, the automobile industry is at present the only principal steel consuming industry in this sector. The manufacturing facilities have been mainly established recently. Factory layout and equipment conform to the requirements of assembly line production. Manufacturing activities at present are confined to assembly. The future programme includes progressive manufacture of engines and other ancillaries by 1978.

The production and import of automobiles in 1968 are given in Table 4-8.

4 - Past consumption and present demand for steels (cont'd)

Table 4-3

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
Passenger cars	[illegible]	[illegible]	[illegible]
Buses and trucks	[illegible]	[illegible]	[illegible]
Others	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]

The bulk of the steel consumed (80 per cent) is in the form of sheets, as at present the plants are only engaged in stamping of body panels and assembly of motor vehicles. The consumption of steel sheets for the production of passenger cars, trucks etc is estimated at about 15,000 tons. Total steel consumption by the transport sector is around 19,000 tons.

Electrical equipment

The bulk of the steel consumption in this sector is mainly for the manufacture of household appliances, while a small amount is being consumed for transformer assembly and construction of substations.

Electrical equipment

The production of electrical appliances in 1980 (obtained by collating the field survey results and available statistics) and total steel consumption are given in Table 4-4.

4. Plant consumption and present demand for steels (cont'd)

Table 4.4

[illegible]

Item	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

The total consumption of steel for the other sectors is therefore estimated at 6,000 tons.

[illegible]

The consumption of steel was of the order of 6,000 tons for the production of ten processing machinery, weighing scales, weighing machinery etc.

[illegible]

The metal products manufacturing industry in Iran is characterized by the existence of a large number of establishments, the large majority of which are small-sized shops. These are reviewed below.

4 - Past consumption and present demand for steels (contd)

Profiles and tubes

According to the production statistics for 1964, four major producers of various kinds of profiles and pipes manufactured from hot rolled mild and low mild steels consumed 187,000 tons of steel as follows:

		Tons
[redacted]	..	[redacted]
[redacted]	..	[redacted]
[redacted]	..	[redacted]
[redacted]	..	[redacted]
[redacted]	..	[redacted]

These profiles and tubes are used for manufacture of furniture, cabins and door frames and other metallic structures.

Tools

Other tools and dies tools are produced in Iran by a number of factories. The field survey reveals that in 1965 the production of tools amounted to 6,000 tons.

Gas cylinders

The total production of gas cylinders was 140,000 units in 1965. On the basis of information obtained from Kuthamajute Dragna Ltd and Tooton Gas Co, the weighted average weight of steel required per gas cylinder is about

4 - Steel consumption and product format for steels (cont'd)

[redacted] by [redacted] the steel consumption with, the total steel consumption for manufacture of gas cylinder would be [redacted] tons.

[redacted]

The production of steel wire was [redacted] tons in 1969. Having wastage of [redacted] per cent, the total requirement of steel for the production of wire rods was [redacted] tons.

[redacted]

Three major manufacturers viz. [redacted] and Company, [redacted] and several domestic appliances on producing a total of [redacted] stoves. The weighted average steel consumption per stove produced by these three firms is about [redacted] kg. On this basis, the total consumption of steel for the manufacture of stoves amounted to [redacted] tons.

[redacted]

Hurricane, mostly stove nuts of mild rolled sheets, are now being manufactured by two companies, [redacted] and [redacted]. The consumption of steel by these two manufacturers in 1969 was of the order of [redacted] tons.

[redacted]

Cans for petroleum, oil and lubricants

There is substantial demand for cans in larger size ranges for petroleum, oil and lubricants. Manufacture of oil cans has been the monopoly of [redacted] factory at Ramanthak

4 - Post consumption and present demand for sheets (cont'd)

and there are no plans for other manufacturing units to be set up. In 1969, Hindustan Packaging consumed 5,000 tons of electrolytic tin plate for manufacture of tin cans. With the rapid growth of the chemicals industry in Iran and the steadily growing market for oil seeds, steel consumption for the manufacture of oil cans is likely to increase.

Vegetable oil cans

The second major container using industry is the vegetable oil industry. The two principal oil manufacturers in this field are Shah Vanaspati Company and Pars Cotton Oil Company.

The total consumption of electrolytic tin plate for the production of vegetable oil containers amounted to approximately 10,000 tons in 1969.

Food cans

The manufacture of fruit and food cans is the least organized. There are many small-scale units, of which the two principal ones are Khuzestan Thermal Metal Box and Khuzestan Cans.

The total consumption of tin plate for the manufacture of fruit and food cans, including a small tonnage for cream cakes and toys, was 5,000 tons in 1969. Out of

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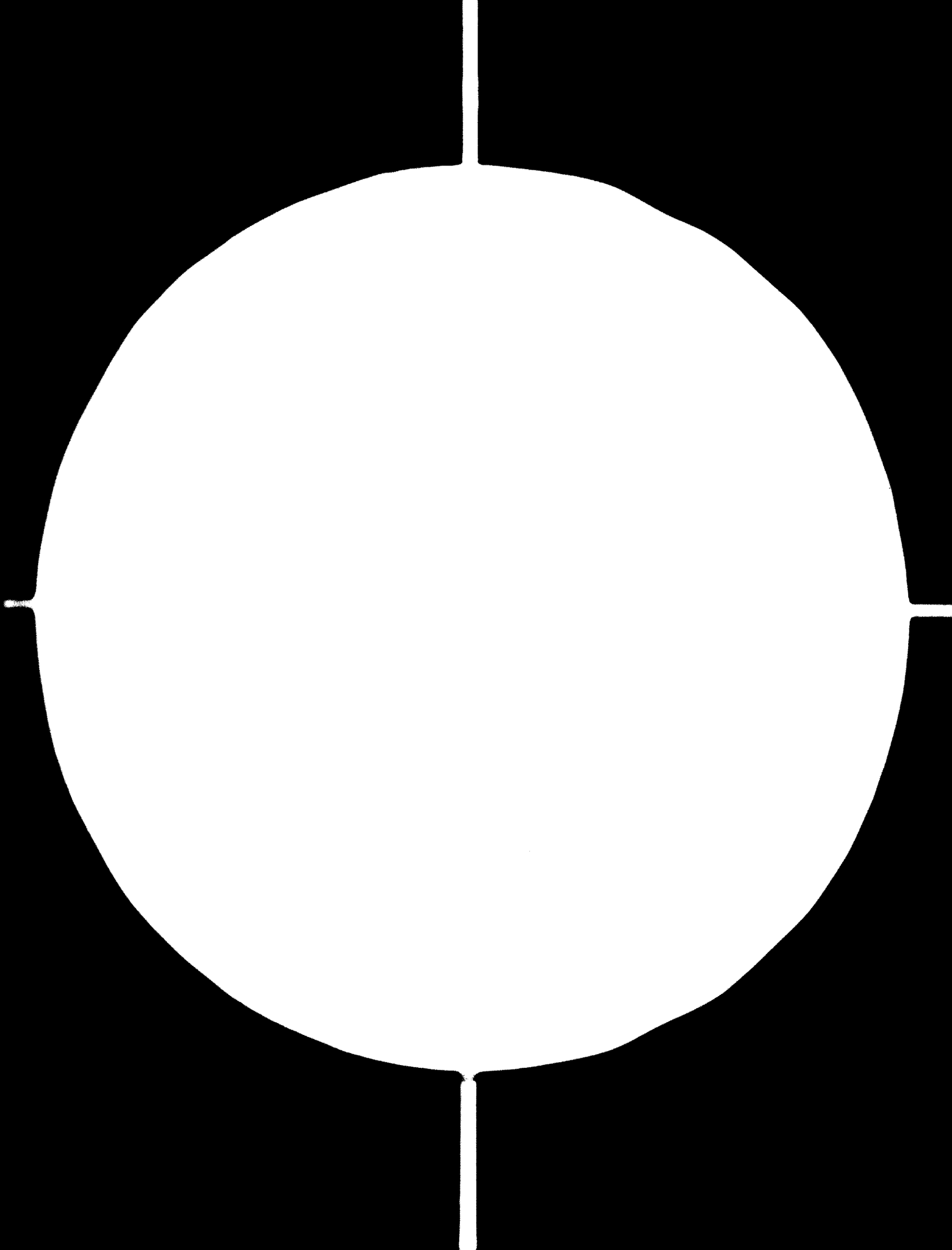

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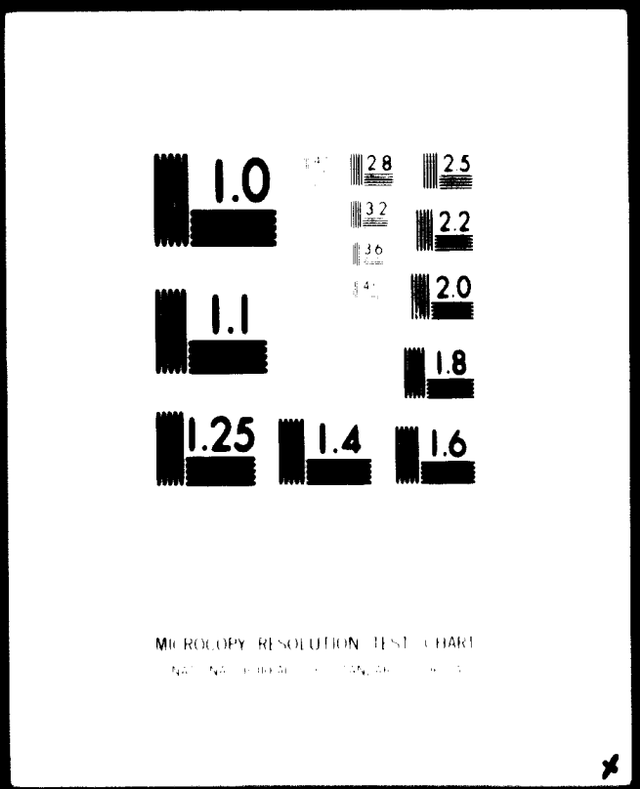

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4 - Past consumption and present demand for steels (cont'd)

this 9,000 tons, 3,000 tons was hot-dipped tin plate for the manufacture of cans to contain acid foods.

Summing up, the consumption of steel for manufacture of tin cans is given in Table 4-5.

Table 4-5

TIN PLATE CONSUMPTION FOR TIN CAN PRODUCTION, 1968

		Tons
Petroleum, oil and lubricant cans	..	8 000
Vegetable oil cans	..	13 000
Fruit and food cans	..	9 000
Total	..	30 000

Welding electrodes

There are at present three units in Iran producing arc welding electrodes. Of these, the Asa Manufacturing Company produces about 12,000 tons and the Kaveh Manufacturing Company some 500 tons of electrodes per year while the third unit, the O.K. Manufacturing Company, commenced operations only recently (August 1969). The total steel consumed by the two units was about 9,400 tons in 1968.

4 - Past consumption and present demand for steels (cont'd)

Manufacturing unit	1968 Electrode production Tons	1968 Steel consumption Tons
Ama Electrode Manufacturing Co	12 000	9 000
Kaveh Manufacturing Co	500	380
Total ..	12 500	9 380
		Say 9 400

Galvanising

Based on import statistics, total steel consumption in the form of galvanised iron sheets is estimated at 35,000 tons. The principal uses of galvanised iron sheets are for roofing and industrial processing.

Galvanised roofing sheets

The estimated regional demand for galvanised roofing sheets is about 60 per cent in the Caspian Sea region, 10 per cent in the Teheran region and 30 per cent in other regions. In the Caspian Sea region galvanised iron sheets are used for housing livestock and construction of store rooms as well as residential houses, whereas in Teheran region they are mainly used for factory buildings and warehouses. The market survey indicated that the consumption of galvanised iron sheets in 1968 for roofing purposes was about 25,000 tons, as follows:

	Tons
Caspian Sea region ..	15 000
Teheran region ..	2 500
Other regions ..	7 500
Total ..	25 000

4 - Past consumption and present demand for steels (cont'd)

Galvanised sheets for other uses

Galvanised iron sheets are also used for the manufacture of domestic electric appliances (heaters, water coolers, etc) and for the construction of ducts of large buildings and private houses. The estimated consumption is about 10,000 tons.

The total present consumption of galvanised sheets in Iran is thus about 55,000 tons.

Steel doors and windows

According to the production statistics, the total tonnage of steel used for the manufacture of steel doors and windows amounted to 35,748 tons in 1968. These are fabricated from profiles formed mainly from cold rolled sheets and to some extent from hot rolled sheets. As steel consumptions for profiles and furniture tubes have already been taken into consideration, steel doors and windows are not separately considered.

Heavy pipes and tubes

The Ahwaz Pipe Mill has two mills, one for the production of 150 mm to 400 mm diameter ERW pipes and the other for 450 mm to 1,050 mm diameter ERW and submerged are welded pipes.

4 - Past consumption and present demand for steels (cont'd)

The capacity of the first mill is 6,000 to 8,000 tons and that of the second mill is 10,000 tons of pipes per month. The combined capacity is therefore 16,000 tons to 18,000 tons per month. The plant produced only about 120,000 tons in 1968. This was totally inadequate to meet the huge demand for the Iranian Gas Tank Line (IGAT) project and by the refineries, oil supply industries and for water supply. The deficit was met by imports and the total pipes and tubes imports in 1968 including fittings amounted to 416,000 tons. Out of the total of 536,000 tons of pipes, tubes and fittings available (120,000 tons indigenously produced and 416,000 tons imported) about 187,000 tons of pipes were utilised in 1968 for IGAT project, which is in the nature of an occasional demand and is not likely to be repeated in future to this large extent.

Summarising the consumption of steel for different items under metal products the total consumption was as given in Table 4-6.

4 - Past consumption and present demand for steels (cont'd)

Table 4-6

CONSUMPTION OF STEEL FOR METAL PRODUCTS

Items		Consumption Tons
Profiles	..	107 800
Tanks	..	6 500
Gas cylinders	..	2 600
Wire nails	..	1 650
Stoves	..	2 250
Steel drums and containers	..	10 000
Tin cans	..	30 000
Galvanised sheets	..	35 000
Pipes and tubes (indigenous production)	..	120 000
Total	..	315 800

Constructional and allied activities

For estimating the steel requirements of this sector constructional activities have been subdivided under various heads.

Industry and mining

The investment allocated for industries and mining sector in the Fourth Plan is 76,800 million Rials, that is an average annual investment of 15,300 million Rials. The steel requirement for this sector was estimated to be of the order of 90,000 tons in 1968 on the basis of norms of steel consumption per million Rials of investment.

4 - Past consumption and present demand for steels (cont'd)

Agriculture and allied activities

A great deal of steel is indispensable for agricultural development and increased farm mechanisation. Iran has allocated 20,000 million Rials for investment on agricultural development during the Fourth Plan. Steel consumption for constructional and allied activities in the agricultural sector is estimated at 22,000 tons in 1968 on the basis of consumption norms.

Oil and gas

The contribution of the oil and gas industries to Iran's GNP was 11 per cent in 1968. Crude oil production in Iran for the period 1962 to 1968 is given in Table 4-7.

Table 4-7

PRODUCTION OF CRUDE OIL IN IRAN

Year		Crude oil production Million tons
1962	..	65.36
1963	..	74.23
1964	..	84.61
1965	..	94.15
1966	..	105.44
1967	..	128.76
1968	..	132.80

Simultaneously the refinery capacity in the country has also increased rapidly from one million tons in 1958 to eight million tons in 1968. The requirement of pipes and tubes and tanks for storage are already considered

under 'Metal Products' and are therefore not considered here. During 1968, for an investment of 5,000 million Rials in oil and gas, the corresponding steel consumption in construction and allied activities is estimated at 8,000 tons on the basis of consumption norms.

Irrigation, roads, bridges etc

For irrigation, roads and bridges, telecommunications, ports and harbour, the annual consumption of steel is estimated at 114,000 tons, on the basis of investments made during 1968 (Table 4-8).

Table 4-8

ESTIMATED STEEL CONSUMPTION FOR IRRIGATION, ROADS, ETC

		Investment in 1968 Million Rials	Steel consumption Tons
Irrigation	..	6 000	45 000
Roads and bridges	..	1 000	12 000
Telecommunication	..	)	
Airports	..	)	57 000
Ports and harbour	..	)	
Total	..		114 000

Social services

Investment on hospitals, educational institutions, stadia, public recreation centres and other social amenities in urban areas of Iran amounted to 27 billion Rials, out of which 21.5 billions were invested in the

construction of new structures and the remaining 5,5 billions in additions and alterations to existing structures. The investment on constructional activities related to social services in 1968 and the corresponding estimated steel consumption are given in Table 4-9.

Table 4-9

ESTIMATED STEEL CONSUMPTION FOR BUILDING CONSTRUCTION

	Estimated floor space 1 000 sq m	Steel consumption norm T/1 000 sq m	Steel consumption 1968 Tons
Steel frame construction	5 475	26	142 000
R.C.construction	1 825	6	11 000
Total			153 000

Power supply

Power supply is divided into generation, transmission and distribution. Installed power generating capacity in 1968 was 350 MW, consisting of 300 MW of hydel and 50 MW of thermal generating capacity. Based on the consumption of 5,600 tons of steel per 100 MW of hydel generating capacity and 5,800 tons per 100 MW of thermal generating capacity, the steel consumption for power generation in 1968 is estimated at 19,700 tons.

4 - Past consumption and present demand for steels (cont'd)

Taking the route length of transmission lines as 400 km of 230 kV line and 300 km of 132 kV line as indicated in the plan programme, and based on the steel consumption norms of 14.6 tons per km of 230 kV line and 11.8 tons per km of 132 kV line, the steel consumption for power transmission lines amounts to 9,400 tons. For power distribution, on the basis of plan programme investment of 705 million Rials and a norm of consumption of 4.8 tons of steel per million Rials invested, the steel consumption is 3,500 tons. The total steel consumption for power supply is as given in Table 4-10.

Table 4-10

STEEL CONSUMPTION FOR POWER SUPPLY, 1968

		Tons
Generation	..	19 700
Transmission	..	9 400
Distribution	..	3 500
Total	..	32 600

Rail transport

In a rapid industrialisation programme, transport development has to be given priority to keep pace with the requirements for material transport. The Fourth Plan targets include the construction of 1,550 kms of

4 - Past consumption and present demand for steels (cont'd)

main and branch lines to meet the transport requirements of the Isfahan Steel Plant, completion of the Sharafkhane-Ghotoor line to link the Iranian railway system with the Turkish and European systems and reconstruction of the Sufian-Jolfa line to improve the railway link with USSR. Based on import statistics, the consumption of rails and railway materials was 69,100 tons during 1968.

Table 4-11 summarises the consumption of steel under each head of 'constructional and allied activities'.

Table 4-11

STEEL CONSUMPTION FOR CONSTRUCTIONAL AND ALLIED ACTIVITIES

	Steel consumption Tons
Large and medium industries and mining ..	90 000
Agriculture and allied activities ..	22 000
Oil and gas	8 000
Irrigation	45 000
Roads and bridges	12 000
Telecommunication, air ports, ports and harbours ..	57 000
Social services ..	153 000
Power supply ..	32 600
Rail transport ..	69 100
Total ..	488 700

4 - Past consumption and present demand for steels (cont'd)

Having reviewed the consumption according to the principal consuming sectors, the total steel consumed during 1968 is given in Table 4-12.

Table 4-12

TOTAL STEEL CONSUMPTION BY SECTORS, 1968

	Steel consumption Tons
Transport equipment ..	37 000
Electrical equipment ..	8 000
Industrial and agricultural machinery	2 000
Metal products ..	315 000
	362 000
Pipes, tubes and fittings for IGAT project and other oil, gas and water distribution network ..	366 000
Sub-total ..	728 000
Spares and maintenance work @ 10% ..	73 000
Sub-total ..	801 000
Construction and allied activities	498 700
Total ..	1 299 700
Stock @ 2% ..	26 000
	1 315 700
Non-coverage ..	37 700
	1 353 400

Taking consumption of alloy steels at 12,000 tons mostly in refineries and automobile industry, the total consumption of all steels in 1968 was 1,365,400 tons.

4 - Past consumption and present demand for steels (cont'd)

REGIONAL DEMAND FOR STEEL

The demand for steel in different parts of a country is dependent on the geographic dispersal of the major consuming sectors. In Iran, the regional demand for steel is closely linked to the development of the major consuming industries in various regions, namely oil and gas, automobile, profiles, consumable durables and basic metallurgical industries.

Population and industries distribution

The majority of industries are centralised in Teheran and a few other provinces. Table 4-13 shows the population and dispersal of industries (other than oil industry).

Teheran province

The main factors that have led to the concentration of industries in and around Teheran are its importance as the country's capital and as the centre of Iran's commercial and economic as well as cultural life. Teheran is the banking centre of the country and provides the biggest market for some of the industries, such as automobile, food and beverage industries. With its two universities and numerous institutions of higher education, Teheran is also the main educational centre in Iran. Skilled

Table 4-13

Table 4-13

DISTRIBUTION OF POPULATION AND INDUSTRIES

Province	Capital city	Population	No. of factories	Industrial workers	Labour force	Ratio of labour force to population
Tehran	Tehran	4 991 875	2 138	165 698	80 374	1.63%
Gilan	Rasht	1 594 138	220	28 288	6 182	0.40%
Azarbaidjan	Tabriz	1 843 388	459	46 157	11 698	0.63%
Khuzestan	Ahwaz	2 484 388	480	35 912	10 207	0.28%
Kermanshah	Kermanshah	888 280	145	17 280	4 996	0.60%
Khorasan	Meshed	1 738 043	132	20 047	1 331	0.06%
Fars	Shiraz	1 391 149	134	26 712	4 990	0.30%
Kerman	Kerman	772 710	117	6 202	1 242	0.16%
Hamadan	Hamadan	2 515 063	261	26 815	6 470	0.25%
Isfahan	Isfahan	1 706 759	380	48 680	15 540	0.90%

Source: Statistical Bureau, Ministry of Economy, Iran.

4 - Past consumption and present demand for steels (cont'd)

workers are more readily available. Climatic conditions are better than in most other parts of Iran. Teheran is also well connected by rail, road and air with the whole country and with the rest of the world.

Khusistan

The biggest oil fields and the Abadan refinery are situated in the Khusistan region, which is the second major industrial centre in Iran. Heavy metal industries such as rolling mills, sponge iron plant, aluminium plant etc, as well as petrochemical plants are being developed, or planned for development in the near future, in this region.

The main reasons for centralisation of industry in Khusistan are the existence in this region of oil and gas and the availability of cheap hydel power. The area is also well connected by road and rail and through the ports of Khorramshahr and Bandar Shahpur.

To avoid this unhealthy concentration of industry in only two provinces, and to promote industrialisation of the rest of the country, the Imperial Government of Iran has adopted in recent years a programme of industrial decentralisation and regional development.

4 - Past consumption and present demand for steels (cont'd)

Regional development and industrial decentralisation

Industrial studies have been undertaken for certain regions in Iran to ascertain the prospects of establishing new industries. More liberal tax exemptions are offered for industries established outside Teheran and Isfahan. Furthermore, licences are being restricted for establishment of industries within a radius of 120 kms of Teheran.

The Imperial Government of Iran has also taken direct steps to promote regional development and dispersal of industries through the establishment of a number of industrial estates in various parts of the country. The three centres selected for the industrial estates are:

i) Isfahan - located centrally in the country and where Iran's first integrated steel plant of an initial capacity of 0.5 million tons with provision for subsequent expansion to 1.2 million tons is now under construction. Related industries such as ferro-alloy plant, alloy steel plant etc are being planned.

ii) Tabriz - situated near the Turkish border in the province of Aserbaijan. Two plants, Machine Sazi and Tractor Sazi are already under construction. The former will cater to the country's requirements of machine tools and the latter to the requirements of tractors. Also under construction is the Derman Long Diesel Engine Plant which will produce stationary diesel engines up to 64 hp.

4 - Past consumption and present demand for steels (cont'd)

iii) Abadan-Ahwas - Shahpur triangular area in the south.

Areawise consumption

It is estimated that at present over 60 per cent of the steel consumed in Iran is utilised in the Teheran region and the remaining 40 per cent is distributed primarily in larger cities, as broadly indicated below:

Principal region		Consumption of steel %
Teheran	..	60
Isfahan	..	10
Ahwas	..	10
Arak	..	5
Tabris	..	5
Others	..	10
Total	..	100

Source: Research Centre, Ministry of Economy, Iran.

In future, the preponderance of Teheran is bound to diminish.

5 - METHODOLOGY OF DEMAND FORECAST AND FIELD SURVEY

Need for demand survey

The gestation period for establishing a steel industry is long even in highly industrialised countries, due to the enormous amount of work involved in planning, in ensuring adequate supplies of raw materials, utilities and transport, and in the actual plant construction itself. Under the conditions existing in developing countries, too much stress cannot be laid on the importance of careful and advance planning for steel. Such planning can be meaningful only when it is based on realistic demand estimates for steel over a long time horizon of ten years and more. The objective of this exercise is to estimate the future steel demand for planning the development of the steel industry in the coming decade. The study therefore cannot confine itself to forecasting the aggregate demand but has also to indicate in detail the types of steels, product categories and size ranges in which they would be needed in the years to come.

5 - Methodology of demand forecast and field survey (cont'd)

Demand forecasting methods

Choice of technique

There are various methods, ranging from simple empirical methods to complicated statistical techniques for projecting/forecasting the demand for an industrial product. The suitability of a particular method would depend on many factors such as the nature of industrial product under study, the objective of the forecast, the level of economic development of a country, the structure of its economy, the extent to which relevant statistical data are available and the time-horison of the projections.

The various techniques generally applied for projecting the demand for an industrial product like steel namely, historical analogy method, trend method, regression method and end-use method are briefly reviewed below.

Historical analogy method

The historical analogy method consists of examining past trends of steel consumption in countries which have reached good levels of economic development and using such trends over specific periods as a guide to projecting steel demand for the country under study. While historical analogy gives some insight into the changing patterns of steel consumption to economic development at different points in time, it does not take

5 - Methodology of demand forecast and field survey (cont'd)

into consideration the effect of technological changes and substitution on steel consumption. Moreover, economic development attained by countries at different stages of growth may not readily be comparable, as the pattern of development could vary widely due to different political and economic systems obtaining in these countries from time to time. Keeping in view the present rapid pace of economic expansion in Iran and the objectives of this demand study, the historical analogy method is not considered relevant to the present exercise.

Trend method

The trend method is based on linear or non-linear time series relationships that can be established on the basis of past consumption. Use of this method, therefore, requires availability of long reliable time series data on consumption of steel. The span of such a time series will depend on the trends that may be considered realistic and on other factors. In an expanding economy starting from a low industrial base, reliable statistics on past consumption are generally not available for long periods. The use of time-trend forecasting is therefore not likely to be reliable.

5 - Methodology of demand forecast and field survey (cont'd)

Regression method

Instead of relating steel consumption (a dependent variable) to time intervals, the regression method correlates this consumption with an independent variable or variables, usually macroeconomic such as national income, gross national product, index of industrial production etc. The correlation may be simple with only one independent variable, or may be multiple involving more than one independent variable. Here again, as in the trend method, a long reliable series of past data is required to establish the relationship or to find out the curve of best fit.

End-use method

The end-use method is basically a derivative approach, and starts with an analysis of the current demand for steel by major consuming sectors in terms of steel types and product categories and sizes. Based on projections for the growth of major steel using industries and sectors as well as the technical norms of consumption, the future pattern and quantum of demand are estimated. Since this method takes into account all major foreseeable changes both structural as well as technological, it has got the best cogency in an expanding economy. Generally, the end-use approach gives estimates on the low side as some new products, technologies and export opportunities

5 - Methodology of demand forecast and field survey (cont'd)

may be missed in the analysis. However, it gives an indication of the aggregate demand but also details of the types of steel, categories of products and sizes which are likely to be needed in future by various industrial sectors in the country. It, therefore, best serves the purpose of planning future steel production in the country.

End-use method adopted

Since the end-use method takes into account the effects of possible changes, structural and technical, in an expanding economy, besides giving the demand estimates in terms of steel types and categories, it has been adopted as the most suitable for the present study. As a result of adopting the end-use method based on micro-level projections, this study can serve as a basic document to provide the broad guidelines both for the development of manufacture of steel consuming items and the steel industry which are closely inter-related.

Need for cross-check

However, accuracy of forecast of output levels of user industries is critical to the entire exercise, and it would be useful to cross-check the output forecasts obtained through field study or plan targets with independent estimates of output of individual manufactured items arrived at by employing proved statistical techniques such as regression method and time-trend analysis.

5 - Methodology of demand forecast and field survey (cont'd)

Accordingly, while the end-use method has been primarily employed to forecast the steel requirement of various steel consuming sectors/products, statistical methods have been used to arrive at independent estimates of the output levels of steel consuming items which could be used to some extent to check the validity of forecasts obtained through field survey and planned targets.

Steps in the end-use method

The application of the end-use method involves four distinct steps.

Identification of end-use

First, the end-use of steels (including alloy steels) in various sectors of the economy are identified.

Determination of output levels

The second step is the determination of the anticipated levels of output/development for each steel consuming product/sector for the years under study, namely 1972, 1977 and 1982.

Norms of consumption

The third step is the establishment of appropriate technical norms of consumption for every single use of ordinary steel and alloy steels on the basis of unit output of the manufactured items and on the basis of unit investment in case of non-manufacturing activities using steel.

5 - Methodology of demand forecast and field survey (cont'd)

Determination of requirement of steel

In the final step, the norms of consumption are applied to the anticipated output of each steel consuming item in manufacturing industries and to the anticipated levels of development in non-manufacturing sectors to arrive at steel requirements, broken down into types and product categories.

Identification of end-use

The identification of various end-uses of tonnage steel and alloy and special steels was carried out by a careful study of the present pattern of steel consumption in various industries/sectors. The consumption of steel in Iran in 1968 by the principal consuming sectors has been discussed in Chapter 4. It is noted that in the field of manufactured items, metal products is the principal steel consuming sector, next in importance being transport equipment. In the transport equipment and metal product sectors, automobile industry and profiles industry respectively are the principal consumers. To ensure maximum coverage, the various user industries/products in each of the major consuming sectors (transport equipment, electrical equipment, industrial and agricultural machinery and metal products) numbering about 70 in all were identified. Constructional and allied activities in large and medium

5 - Methodology of demand forecast and field survey (cont'd)

industries, mining, agriculture, oil and gas, irrigation, social services, power supply and transport constitute another major area of economic activity consuming steel on a large scale. For such constructional activities, the investments allocated during the plan periods are considered.

Allowance for non-coverage

In the manufacturing sector, large scale industries are not numerous. Therefore, an attempt was made at complete coverage, but it was not possible to make personal visits/interviews with each and every unit. Therefore, while establishing output levels of currently manufactured items, due allowance has been made for non-coverage.

Output and development levels

The output levels of items which are currently manufactured have been determined on the basis of field survey. For certain items which are not manufactured at present but are likely to be manufactured in future, output levels have to be based on the plan programmes envisaged by various government and non-government authorities. The validity of the assessment being dependent on the correctness of output levels assumed for steel consuming items, a cross-check with projections by other techniques is useful. For instance, independent projections of the output levels of as many as thirty-six out

5 - Methodology of demand forecast and field survey (cont'd)

of seventy consumer items arrived at by time-trend and regression techniques based on past availability have been compared with the industries' own estimates of output levels and plan programme output levels, in Chapter 6.

Norms of consumption

For forecasting demand by the end-use method it is essential to establish the norms or the input coefficients of steel consumption, that is ,the gross quantity of steel (including processing loss) going into each unit of the consuming item manufactured by the industrial sector or each unit of investment in constructional and allied activities. The unit can be in terms of weight, number, value or any other definable measure appropriate to the consuming product or sector. Taking into consideration the possible product diversification, technological changes and structural changes in economy, norms of consumption for certain relevant manufactured items have been worked out separately for the years 1972, 1977 and 1982. The norms used for various end-products are given in Chapter 6.

Determination of aggregate demand

The last step in the end-use method is to arrive at the aggregate demand. This is done by applying the norms of consumption to the anticipated levels of output/development for the years under study.

5 - Methodology of demand forecast and field survey (cont'd)

Factors considered

The following additional factors have also to be taken into consideration to arrive at overall demand estimates:

i) steel content of manufactured items meant for export;
ii) steel, semis and ingots meant for export;
iii) substitution of steel by other materials such as aluminium, plastics, glass etc; and
iv) steel imports.

Exports

Iran being in the process of industrialisation, substantial exports of manufactured items is not likely for quite some time to come. Exports of steel from Iran may become feasible when near self-sufficiency in steel production is attained. However, as Iran does not possess advantages of cheap and abundant raw material resources required for steelmaking or cheap labour, it will be difficult for Iranian steel to compete successfully in international markets. Exports from Iran are therefore likely to be small and limited to neighbouring countries such as Pakistan. Even when a fairly large and well developed steel industry is established, Iran - like most other countries - may have to depend to some extent on imports of some quantities of alloy and special steels and small tonnages of speciality steel products. However, by the time a near self-sufficiency in steel is reached,

5 - Methodology of demand forecast and field survey (cont'd)

the quantum of imports would be only a small fraction of the total demand. Therefore, for the purpose of computing the aggregate steel demand and shortfall and in planning to meet the same, steel imports upto 1977 may be considered negligible. In view of the high price and non-availability of aluminium, plastics and glass, it is very unlikely that there would be any substantial substitution of steel by these materials before 1982, which would affect the steel demand.

Cross-checks by statistical forecasting methods

Time-trend method and regression method (simple/multiple) were used to cross-check the total tonnage steel and alloy steels demand projections by the end-use method as well as the output levels of some of the manufactured items.

Time-trend method

The time-trend method, based on linear or non-linear time series relationship that can be established for availability of consuming items in the past, assumes that the past trend would also continue in future. This method does not take into account certain growth factors in expanding economies where economic growth may be accelerated by special techno-economic measures. For instance, it was found that projections of the output levels of many

5 - Methodology of demand forecast and field survey (cont'd)

manufactured items by time-trend analysis were not truly reflective of the rapid pace of Iran's industrialisation and generally yielded much lower values than those obtained through field survey. However, in the case of certain items, the trends of which have been more or less stabilised during the past few years, the time-trend output projections compared favourably with output levels obtained through field survey.

Regression method

Various steel consuming items in each sector have been projected by regression analysis. Only simple regression method, that is relating the end-product (dependent variable) to an independent variable, an economic indicator was used. The economic indicators used as independent variables for correlation with each dependent variable are listed below:

5 - Methodology of demand forecast and field survey (cont'd)

Sector	Independent variable
A. Transport equipment	
Buses and mini-buses	Population
Passenger cars	Per capita income
Trucks	Index of industrial production
B. Electric equipment	
Electric fans, Air coolers, Water coolers, Water heaters, Radio receivers	Per capita income
C. Industrial and agricultural machinery	
Industrial boilers	Index of industrial production
D. Metal products	
Steel wire ropes, Bolts, nuts and rivets, Ball and roller bearings, Builders hardware	Index of industrial production
Stoves, Sewing machines	Per capita income
Arc welding electrodes	Index of industrial production
Razor blades	Population
Hacksaw blades	Index of industrial production

The following independent variables were selected for projection of the aggregate tonnage steel and alloy steels demand by regression analysis:

5 - Methodology of demand forecast and field survey (cont'd)

Tonnage steel demand	Independent variable
Simple regression	National income
Simple regression	Index of industrial production
Multiple regression a/	National income and index of industrial production
Multiple regression a/	Index of industrial production b/ and constructional activity

Alloy and special steel	
Simple regression	National income
Simple regression	Index of industrial production
Multiple regression a/	National income and index of industrial production

a/ Computer used for projection.

b/ Constructional activity has been chosen as one of the two independent variables because steel consumption in constructional activity accounts for nearly half the total steel consumption in Iran.

a/ Multiple regression analysis taking constructional activity as one of the two independent variable has not been done because alloy and special steels are hardly used for construotional purposes.

Assumptions

Any demand forecast has to be based on some assumptions as the future cannot be defined in absolute terms. Reliability of such forecasts will depend to a great extent on the validity of the assumptions made. For the purpose of this study, the following assumptions have been made:

i) The production of different steel consuming items of which output forecasts have been based on planned programmes will materialise according to plan.

5 - Methodology of demand forecast and field survey (cont'd)

ii) The growth rate of national income will be 9.5 per cent a year between 1967 and 1972, 8.5 per cent between 1972 and 1977 and 7.5 per cent between 1977 and 1982. The index of industrial production will increase at the rate of 15 per cent per annum between 1967 and 1972, 12 per cent between 1972 and 1977 and 11 per cent between 1977 and 1982.

iii) Population will increase at the rate of 2.8 per cent a year and exponential relationship will hold good for estimating the population in future years.

iv) For industries yet to be developed norms of steel consumption derived for manufactured items in other countries at a similar stage of development will also hold good for Iran.

v) Investment policies in different economic sectors as outlined in National Development Plan and other related documents issued by the Imperial Government of Iran will be followed.

vi) There will be little substitution of steel by other materials before 1982. In building construction, r.c. construction will progressively replace steel frame construction in future as a result of general government policy now being implemented.

vii) The investments in different economic sectors during each plan period will be more or less equally phased over each year of the plan period.

It is assumed that projections obtained by correlating the average annual investment levels in the different economic sectors during the Fourth Plan period with the envisaged growth rates of the related economic indicators in the Fifth and Sixth Plan periods will hold good as reasonably valid estimates of the average annual investment levels in these sectors during the Fifth and Sixth Plan periods.

5 - Methodology of demand forecast and field survey (cont'd)

Field survey

An important feature of this study on assessment of demand for steel in Iran is the field survey designed for detailed analysis of the market for steel in the country. To make the coverage comprehensive, detailed lists of firms in each major industrial group were drawn up on the basis of data culled from various industrial directories and publications. These were scrutinised and supplemented by information available with various other agencies such as the Plan Organisation, Industrial Development and Reconstruction Organisation, Industries and Mining Development Bank of Iran and Bank Markasi.

After scrutiny of available data, firms which consume little or no steel were taken off the list. The various industries/firms covered by the field survey and organisations contacted in this connection are listed in Appendix 5-1.

Extent of coverage

The extent of coverage by the field survey of manufactured items in different industrial sectors is given below:

5 - Methodology of demand forecast and field survey (cont'd)

I - 100% coverage

Transport equipment

1. Automobiles and trailers
2. Automobile ancillaries
3. Leaf and coil springs
4. Railway rolling stock
5. Vehicular diesel engines

Metal products

1. Arc welding electrodes
2. Bandsaw and hacksaw blades
3. Pipes, tubes and profiles
4. Razor blades

Industrial and agricultural machinery

1. Agricultural tractors
2. Power driven pumps
3. Stationary diesel engines

II - Over 85% coverage

Transport equipment

1. Miscellaneous transport equipment

Power generation and electrical equipment

1. Aircoolers and air-conditioners
2. Cables and transmission towers
3. Radio receivers and television sets
4. Refrigerators (domestic and commercial)
5. Switchgear and control gear
6. Water coolers and water heaters

Industrial and agricultural machinery

1. Agricultural implements
2. Building and road construction machinery
3. Industrial boilers
4. Machine tools and accessories
5. Small tools and hand tools

5 - Methodology of demand forecast and field survey (cont'd)

Metal products

1. Bolts, nuts and rivets
2. Builders' hardware
3. Gas cylinders
4. Steel furniture
5. Steel drums and containers
6. Tin cans
7. Tanks
8. Utensils
9. Wire nails and other wire products

III - Between 65% and 85% coverage

Transport equipment

1. Bicycles and bicycle parts

Power generation and electrical equipment

1. Electric transformers
2. Electric motors

Industrial and agricultural machinery

1. Food processing machinery

Civil construction

1. Structurals

Questionnaire

Questionnaires covering various aspects of the study were framed, in order to elicit information from as many steel user industries as possible and also from the various related government authorities and private agencies, including the steel trade. Comprehensive questionnaires were prepared for:

5 - Methodology of demand forecast and field survey (cont'd)

i) Tonnage steel demand in Iran (Appendix 5-2)

ii) Alloy steels demand in Iran (Appendix 5-3)

iii) Imports of ordinary and alloy steels (Appendix 5-4)

Scope of Questionnaires

In order to get prompt and meaningful response the questionnaire were field tested for clarity, translated into Farsi and issued to about 280 consumers and importers. The industrial units were requested to give specific information on the following aspects:

i) product/products manufactured in which tonnage steel and alloy and special steels are consumed and actual production;

ii) consumption of tonnage steel and alloy steels per unit output of the product;

iii) category of tonnage steel, types of alloy steels and sizes required;

iv) brand names as well as corresponding Iranian/ Indian/or International standards;

v) under-utilisation of capacity, if any, and reasons thereof;

vi) stocks maintained;

vii) the present source of procurement; and the

viii) future estimated output for each type of product.

5 - Methodology of demand forecast and field survey (cont'd)

The importers and dealers of tonnage steel and alloy and special steels were requested to furnish information on -

i) past and present imports of tonnage steel and alloy steels by types and categories; and

ii) anticipated imports of tonnage steel and alloy steels for future years.

Plant visits

Major steel consumers and importers of steel in Teheran and other cities were interviewed on a selective basis by three teams of engineers, assisted by interpreters from the Bureau of Statistics of the Ministry of Economy. In several cases repeated visits had to be made to these establishments to cross-check data, ascertain consumption norms and elicit the views of the company officials on development programmes, government policies and the pace of import substitution.

Response to questionnaire

The questionnaires were issued to various consuming industries, government authorities and private bodies. It was anticipated at the outset that written response to the questionnaires would be poor. Therefore, visits to the industries and personal interviews and discussions were initiated simultaneously. A fairly large proportion of

5 - Methodology of demand forecast and field survey (cont'd)

tonnage steel and alloy steels consuming industries were covered by these visits.

A break-down of the number of questionnaires sent out, visits made and response received is given below:

Questionnaires sent out ..	280
Written response (excluding interviews)	5
Visits and discussions ..	100
Parties giving meaningful replies	100
Parties reporting negligible consumption	5

Collation of data

The information obtained from replies to questionnaires was tabulated separately for each sector of manufactured items to determine steel type and product category for each major industrial/consuming sector as well as each individual item. Where data furnished by the firms were incomplete or not precise, assumptions based on prevailing practices were made. Some firms were either uncertain about or could not precisely spell out their future programme. In such cases, projections were made on the basis of the growth rate of selected economic indicators. Some firms were over-optimistic and expected to double their production by 1972 and treble it by 1977. In such cases the subjective estimates of future production were considered acceptable only if a scrutiny of the existing facilities and expansion

5 - Methodology of demand forecast and field survey (cont'd)

programmes warranted the feasibility of such increases. If not, the production level forecasts were suitably adjusted to realistic levels on the basis of growth rates indicated by past trends.

Norms from field survey results

On the basis of consumption of tonnage steel and alloy steels for manufactured items by industries visited during the field survey, norms of consumption were established. In some cases where a precise breakdown of consumption norms by steel types and product categories could not be obtained from the manufacturing unit, and also in the case of items not manufactured now but are likely to be manufactured in future, consumption norms were evolved from practices prevailing in similar economies.

Details of consumption norms, output levels of steel consuming items and the estimated demand for tonnage steel and alloy and special steels are discussed in Chapter 6.

APPENDICES

Appendix 4-1

IRON AND STEEL IMPORTS, 1962 TO 1968

(quantity in tons)

Iron and steel items	Tariff code No.	1962	1963
A. Iron products			
Pig iron	696	6 692	2 432
Scrap and chips	698	2 795	5 [illegible]
Sub-total (A)		9 487	7 724
B. Cast iron pipes			
Pipes	708A	6 803	10 852
Pipe fittings	708B	1 787	[illegible]
Sub-total (B)		8 590	11 467
C. Steel products			
1. Ingots			
Ingots	699	38[illegible]	[illegible]
Blooms and billets	700	[illegible]	[illegible]
Sub-total (1)		47[illegible]	15[illegible]
2. Structurals			
Beams	701-2	101 568	[illegible] 891
Channels	701-3	8 471	8 894
Angles	701-5	40 61[illegible]	[illegible] 659
Tees	701-6	1 115	[illegible] 624
Sections	701-7	[illegible]	[illegible]
Sub-total (2)		139 7[illegible]	1[illegible] 418
3. Bars and rods			
Rods	701-1	19 17[illegible]	[illegible] 599
Rounds	701-4	[illegible] 875	[illegible] 521
Other shapes	701-8	[illegible]	[illegible]
Sub-total (3)		29 260	[illegible] 399
4. Wires			
Below 0,5 mm dia	708A	849	604
Above 0,5 mm dia	708B	[illegible]	[illegible]
Sub-total (4)		17 [illegible]	15 844
5. Rails and railway materials			
Rails	713	587	[illegible]
Sleepers and other railway materials	714, 715, 716 and 717	[illegible]	[illegible]
Sub-total (5)		3 5[illegible]	[illegible] 555

SECTION 1

Appendix 6-1

…ON AND STEEL IMPORTS, 1948 TO 1949

Appendix 6-1

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	6 448	2 492	10 181	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	9 407	7 784	[illegible]	[illegible]	[illegible]	[illegible]	31 537
	6 809	10 808	8 504	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	8 590	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	170	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	67	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	1 113	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SECTION 2

Iron and steel items	Tariff code No	1962	1963	1st
Steel products (cont'd)				
6. Steel pipes, tubes and pipe fittings ..	709 to 712	72 677	60 217	125
7. Flat products				
Sheets and plates uncoated	703 and 704A	50 481	44 360	66
Galvanized sheet	704B	17 512	16 199	25
Tin plate	704Bb	10 339	9 996	11
Sheets (Ni and Cr plated)	704C	3 683	100	
Sheets (others)	704D and 705	3 503	1 256	1
Hoops	706	1 778	2 207	3
sub-total (7)		87 296	74 118	111
8. Ferrous steel	707	295	625	1
Total steel products (C) ..		347 338	335 185	508
Total iron and steel products (A + B + C)		365 415	371 370	539

SECTION 1

Appendix 4-1 (continued)

	1962	1963	1964	1965	1966	1967	1968
712	72 677	60 217	125 983	174 172	106 376	283 155	416 064
nd 704A	50 481	44 360	66 912	111 135	129 578	304 707	320 680
	17 512	16 199	25 634	23 556	23 234	33 532	38 465
	10 339	9 996	14 670	21 449	27 401	23 530	31 392
	3 663	100	32	49	148	100	105
nd 705	3 503	1 256	1 745	1 839	2 274	2 818	1 672
	1 778	2 207	2 770	6 797	6 761	9 531	5 586
	87 296	74 118	111 763	154 825	189 396	373 218	397 880
	295	625	1 277	3 514	3 972	35 219	38 494
	347 338	355 485	505 069	684 840	719 748	1 214 827	1 385 364
	365 415	374 576	539 237	726 477	745 949	1 251 360	1 404 551

SECTION 2

Appendix 4-2

IMPORTS OF SELECTED ENGINEERING ITEMS 1962
(Quantity in tons and value in '000 Ri

Description	Tariff code No	1962 Qty	1962 Value	1963 Qty	1963 Value	1964 Qty	1964 Value
A. Transport equipment							
Railway wagons (Nos.) ..							
Trailers ..	898B-1	497	40 293	114	8 835	120	30
Trailers' parts ..	898B-2	11	1 785	...	...	...	..
Merchandise carriages not mechanically propelled ..	898A-1	184	9 654	95	8 014	75	3
Hand trailers, spare parts ..	898A-2	8	1 939	...	...	...	..
Motor coaches ..	890B-1	215	28 675	154	17 971	889	113
Motor buses ..	890B-2	304	50 464	157	31 389	81	14
Vannets ..	890C-2-2	296	31 196	1 039	109 381	2 838	267
Passenger cars ..	890A	4 316	377 455	8 435	967 850	13 [illegible]	1 698
Motor car engines and parts ..	823A-2,3,4	2 634	568 742	2 139	493 960	2 131	507
Trucks ..	890C-1	1 830	201 283	463	57 807	1 673	157
Trucks - electric ..	890D	...	-	15	534	-	-
Jeeps and station wagon ..	890E-2	147	22 209	135	17 137	155	18
Three wheelers ..	890C-2-4	-	-	94	6 471	193	21
Three wheelers engines and parts	823A2-6 and 7	-	-	-	-	-	-
Motor cycles ..	894-1	152	21 378	304	39 708	677	86
Pedal cycles, motor assisted ..	894-2	74	11 499	120	16 647	248	27
Motor cycle parts and fittings ..	896-1	44	8 500	90	11 794	225	21
Motor cycle and pedal cycle engines	823A-1,2,5	27	10 535	36	16 707	62	22
Automobile ancillaries - passenger car parts ..	893A-1	131	19 721	340	42 074	105	17
Parts and fittings for bus, coach, lorry etc ..	893B-1	4 057	659 398	3 677	570 923	4 282	659
Vehicle leaf springs ..	732-A	1 550	43 549	1 677	46 470	1 794	50
Vehicle coil springs ..	732-B	98	4 594	38	2 410	24	2
Furniture and other springs ..	732-C and D	247	11 959	166	7 584	177	8
Vehicular diesel engines ..							
Other road transport equipment ..							
Bicycles ..	895-1	1 580	152 989	1 835	181 371	1 364	122
Bicycle parts ..	896-2	511	32 035	681	41 121	709	37
Tricycles ..	895-2	...	...	...	...	18	1
Ships, crafts and boats (marine boat engines and parts) ..	823A1-3 to A1-5	27	7 172	52	8 962	69	8
Aircraft engines and parts ..	823A1-1 and A1-2	21	53 133	25	56 740	65	134
Other transport equipment ..							
B. Electrical equipment and machinery							
Dynamo alternators ..	859-1	138	26 874	1 386	193 458	1 174	194
Transformers (2 kW capacity) ..	859-6	53	6 799	698	91 668	913	77
Transformers (2 kW capacity) ..	059-7	39	4 348	16	2 416	9	

INEERING ITEMS 1962 TO 1968
and value in '000 Rials)

Value	1964 Qty	1964 Value	1965 Qty	1965 Value	1966 Qty	1966 Value	1967 Qty	1967 Value	1968 Qty	1968 Value
835	120	30 078	529	38 846	760	52 309	1 511	148 272	1 649	150 205
...	...	...	231	24 063	62	16 673	361	50 967	451	45 158
014	75	3 765	21	1 811	23	1 602	61	9 276	76	8 952
...	...	...	20	1 699	34	2 511	43	2 942	41	3 248
971	889	113 843	954	113 586	498	58 207	283	40 217	195	21 991
389	81	14 739	66	11 042	408	51 927	361	42 051	198	24 055
381	2 838	267 835	1 906	200 290	1 697	191 796	2 320	244 671	4 989	500 345
850	16 041	1 698 405	13 887	1 386 015	16 194	1 739 531	13 033	1 540 887	13 224	1 514 348
960	2 134	507 123	1 483	364 712	1 344	353 337	1 248	363 907	2 749	952 788
807	1 673	157 271	2 639	260 182	5 255	546 953	7 154	809 847	6 573	682 160
534	-	-	1	240	-	-	10	2 189	27	4 041
137	155	18 021	282	59 288	312	60 451	545	69 206	606	92 281
471	193	21 063	237	19 559	270	21 719	1 183	97 313	1 197	128 802
-	-	-	22	9 340	31	13 232	44	18 354	52	30 853
708	677	86 612	1 378	183 898	1 731	222 063	1 710	100 711	2 410	247 034
647	248	27 873	318	27 882	388	21 719	859	57 751	1 239	85 635
794	225	21 504	276	25 995	399	35 093	233	24 920	213	23 187
707	62	22 502	101	45 386	162	80 379	201	93 330	218	91 703
074	105	17 288	492	54 028	679	117 681	1 205	177 997	614	105 671
923	4 282	659 048	5 250	861 470	6 386	916 303	6 421	1 064 899	7 645	1 282 310
470	1 794	50 678	2 770	73 410	3 900	102 275	4 068	108 262	2 233	56 570
410	24	2 204	56	4 441	84	7 018	110	8 993	83	7 160
584	177	8 791	298	10 983	333	15 455	243	14 350	344	17 443
371	1 364	122 372	1 867	153 775	1 391	117 611	1 262	106 327	2 043	163 758
121	709	37 642	797	42 353	627	33 579	765	36 542	640	38 067
...	18	1 713	44	4 506	42	3 854	30	2 542	51	5 594
962	69	8 450	86	19 720	32	14 473	32	10 310	27	13 913
740	65	134 825	47	70 546	65	71 787	52	57 009	45	44 685
458	1 174	194 796	1 663	294 530	1 874	325 740	4 623	698 608	3 304	683 699
668	913	77 244	243	21 231	313	26 644	346	32 383	337	35 915
116	9	990	808	83 719	2 127	246 324	3 153	333 069	3 857	432 101

Description	Tariff code No	1962 Qty	1962 Value	1963 Qty	1963 Value	1964 Qty	1964 Value	1. Qty
B. Electrical equipment and machinery (cont'd)								
Electric motors ..	859-4 and 859-5	1 459	138 277	651	74 935	828	83 724	983
Power boilers and accessories ..	-	-	-	-	-	-	-	-
Switchgear and control gear ..	878-3	-	-	-	-	549	41 634	1 109
House service meters (a) current measuring and registering equip	872-A	25	12 484	18	11 095	74	26 620	23
Electric meters ..	872-B	268	79 808	161	48 604	183	53 209	140
Industrial fan and blowers - mechanical ventilators ..	828-4	34	5 702	98	19 726	135	26 348	213
Blowers ..	828-5	...	...	59	5 448	17	2 100	27
Other electrical equipment ..	871C-1	3	1 050	2	959	2	1 248	8
Parts for electrical equipment ..	871C-2	2	1 324	-	319	3	1 246	6
Parts for other electrical equipment and machinery (nes) ..	878-5	222	37 892	112	17 604	1 119	232 921	2 073
Electric fan - up to 15 kg wt ..	862-B1	589	74 000	649	73 507	636	80 632	772
Electric fan - over 16 kg wt ..	854B-2-6	-	-	-	-	-	-	4 052
Air coolers ..	839A-4,5 and 6	455	75 223	723	126 492	1 025	191 925	523
Refrigerators(domestic and commercial):								
Electric ..	839A-1	458	56 435	39	4 461	125	16 528	90
Non-electric ..	839A-2	24	2 505	42	3 534	135	10 208	130
Deep freezers ..	839A-3	53	11 084	63	13 299	124	23 392	48
Parts - Refrigerators and deep freezers ..	839A-7	-	-	-	-	-	-	915
Refrigeration plant ..	839B-1-2	83	14 363	32	8 581	52	11 707	111
Refrigerating machinery and parts thereof ..	839B-2-2 and 3	232	32 322	32	6 002	113	14 029	156
Water coolers ..	839B-2-1	139	20 669	32	10 904	143	37 130	42
Water heaters (non-electric) ..	838B-5	770	72 452	21	4 721	67	6 313	17
Radio receivers ..	868B-1	329	100 940	30	17 349	44	23 932	104
Television sets ..	868B-2	28	7 737	2	615	6	1 487	6
Parts, receivers sets (nes) ..	868B-6	-	-	350	169 451	858	390 004	810
Tele-communication equipment ..	869A and B	475	258 673	233	167 647	506	323 995	894
P.A. system and parts ..	869-C1 and C2	9	5 308	15	5 001	29	8 306	30
Other electrical appliances	-	-	-	-	-	-	-	-
C. Industrial and agricultural machinery								
Other drilling equipment (well drilling) ..	893A1 and A2	4 776	426 246	1 302	246 703	1 862	297 089	4 822
Agricultural trailers ..	889-1	4 284	477 932	3 038	396 486	9 788	1 019 326	9 819
Parts, tractor body ..	889A-2	2	371	1	366	48	1 664	6
Parts and fittings, tractor ..	893B-2	380	86 897	532	109 524	942	189 777	610
Agricultural implements ..	741 to 743	962	29 101	1 219	39 382	1 472	53 190	1 441
Other agricultural equipment ..	834, 835 and 836B	3 853	410 330	2 075	212 761	5 927	634 128	4 100

...ie	1964 Qty	1964 Value	1965 Qty	1965 Value	1966 Qty	1966 Value	1967 Qty	1967 Value	1968 Qty	1968 Value
935	828	83 724	983	117 257	1 483	190 373	1 996	342 153	2 249	269 752
	-	-	-	-	-	-	-	-	-	-
	549	41 634	1 109	138 889	942	136 560	1 512	268 385	2 573	479 307
095	74	26 620	23	19 010	66	32 309	39	26 465	82	43 792
604	183	53 209	140	43 154	251	69 852	213	75 421	353	106 365
726	135	26 348	213	39 542	242	50 871	430	78 861	371	76 095
148	17	2 100	27	2 702	32	4 483	35	3 369	25	5 068
959	2	1 248	8	4 062	21	8 617	8	4 668	11	4 390
819	3	1 246	6	3 843	15	9 022	9	4 056	17	7 254
604	1 119	232 921	2 073	315 909	1 842	364 670	3 438	770 324	2 906	598 868
507	636	80 632	772	107 325	1 206	128 027	1 495	175 897	1 282	159 678
	-	-	4 052	391 240	2 801	426 306	340	22 144	119	8 595
492	1 025	191 925	523	105 142	764	156 363	629	140 308	496	110 566
461	125	16 528	90	13 488	54	8 435	54	9 377	78	17 259
054	135	10 208	130	11 650	166	16 075	207	10 014	99	10 249
299	124	23 392	48	12 045	5	1 004	6	1 160	83	13 260
	-	-	915	156 456	755	137 808	946	187 388	779	155 812
581	52	11 707	111	20 237	87	19 972	418	51 557	367	89 739
002	113	14 029	156	34 800	193	51 464	374	87 433	770	114 965
904	143	37 130	42	11 183	33	10 155	108	26 549	20	5 145
721	67	6 313	17	3 428	28	4 350	51	12 949	98	23 243
349	44	23 932	104	56 708	24	19 337	45	24 713	37	22 088
515	6	1 487	6	1 906	11	3 987	43	22 232	34	12 445
451	858	290 004	810	404 110	477	235 652	333	204 940	420	272 036
647	506	323 995	894	525 310	593	305 867	790	452 499	1 690	807 125
001	29	8 306	30	6 884	47	10 840	75	19 079	115	28 129
-	-	-	-	-	-	-	-	-	-	-
703	1 862	297 089	4 822	541 622	5 852	686 182	8 941	1 108 569	3 008	688 029
486	9 788	1 019 326	9 819	1 118 921	10 708	999 251	13 656	1 098 610	12 764	1 109 285
366	48	1 664	8	869	22	2 282	1	692	291	36 126
524	942	189 777	610	130 708	999	186 153	838	182 465	615	120 856
382	1 472	53 190	1 441	48 621	1 013	29 293	1 189	27 294	1 490	53 467
761	5 927	694 188	4 100	504 296	4 914	492 433	6 853	504 257	6 887	574 292

Description	Tariff code No	1962 Qty	1962 Value	1963 Qty	1963 Value	1964 Qty	1964 Value	Qty
C. Industrial and agricultural machinery (Cont'd)								
Earthmoving machinery ..	858B-6	-	-	-	-	-	-	2
Road construction (including road rollers machinery) ..	826 and 833B5	2 714	265 768	1 555	166 360	886	69 660	4 67
Stationary diesel engines and parts	823B3 and B4	182	54 815	400	118 680	804	156 702	22
Stationary engine I.C. and parts ..	823B5 and B6	3 776	553 230	4 530	632 161	5 773	883 491	9 21
Cranes ..	N.A.							4 1
Passenger and industrial lifts ..	833B7 to B9	-	-	-	-	-	-	11
Fork lifts ..	833B-2	20	2 113	117	11 340	49	4 952	61
Other material handling equipment..	833B-1	751	77 634	305	36 742	1 033	110 786	
Industrial boilers and accessories	820-1 and 820-2	456	115 408	1 076	100 354	801	91 337	1 1
Industrial furnaces (up to 1 ton)..	865A2	25	1 351	7	1 220	8	2 245	
Industrial furnace parts ..	865A3	-	-	99	6 468	51	2 032	
Compressors - air and gas ..	828-3	103	20 791	220	39 259	425	83 480	69
Dye sprinkling ..	828-7	-	-	277	77 147	339	93 952	
Compressor - refrigerators ..	828-8	-	-	-	-	99	16 520	5
Hand pumps, deepwell pumps and parts	827	10 617	684 276	10 537	589 194	15 352	849 245	23 0
Air and tyre pumps ..	828-1	380	64 644	50	6 404	181	14 907	
Vacuum pumps ..	828-6	382	89 865	2	902	2	314	
Textile machinery and parts ..	844 and 845	1 007	130 563	1 633	246 693	2 502	361 028	3 1
Carding machine and spinning machinery parts ..	857B-2 and 857B-5	290	80 820	425	101 364	542	145 702	6
Shoe and leather machinery ..	841	59	9 742	71	12 577	104	20 214	
Dairy machinery and parts ..	836A	41	12 547	18	5 784	33	11 390	
Tea machinery ..		-	-	95	3 430	123	13 155	1
Paper and pulp machinery and parts	842	103	12 478	126	22 310	197	39 861	2
Printing machinery and parts ..	843	71	18 683	46	18 431	150	82 278	
Food processing machinery and parts	837-1,2,3,6 and 854B-1	1 133	83 280	821	55 768	1 562	192 843	1
Weighing equipment and parts ..	850	187	10 223	145	10 706	168	12 718	1
Machine tools, accessories and parts	848B	799	126 459	1 309	209 238	2 427	310 413	3
Small tools and hand tools ..	744,745,746	475	58 626	480	49 358	658	67 882	
	747,750 and 751	264	45 109	119	29 782	259	53 010	
Knives hand and fancy ..	804	5	2 030	17	4 077	12	3 792	
Knives, blades ..	805	-	241	-	38	2	562	-
Jacks, hand and hydraulic ..	833B3 and B4	532	49 411	577	71 765	3 348	492 180	1
Pneumatic tools ..	848A-2	241	27 004	35	7 063	43	10 648	1
Portable tools ..	862-A	7	2 136	26	10 370	45	16 305	1
D. Metal products								
Utensils - hollow ware, household..	740A,B,C, D and E	219	39 840	208	30 241	348	52 408	
Cooking vessels and foreign pan - electric ..	865B3 and B4	1	412	2	379	1	164	-
Cutlery and table ware ..	802,803,809 and 810	276	40 852	320	43 926	460	69 358	2

1964		1965		1966		1967		1968	
Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value
-	-	27	3 363	237	21 205	138	23 547	181	31 279
886	69 660	4 676	510 261	7 516	692 260	3 322	391 177	2 093	285 114
804	156 702	225	36 519	199	60 132	314	43 979	244	37 085
5 773	883 491	9 217	883 481	7 564	1 455 956	11 034	2 279 055	11 693	2 528 095
-	-	4 185	485 096	9 003	865 501	8 174	1 015 020	10 140	1 375 957
49	4 952	110	12 841	206	25 575	436	46 543	612	78 995
1 033	110 786	614	62 871	1 891	230 564	4 894	633 800	4 116	474 075
801	91 337	1 142	127 615	4 553	685 347	3 251	506 097	2 344	343 483
8	2 245	57	6 026	14	2 331	49	10 493	232	25 834
51	2 032	34	4 996	26	3 530	2	699	164	12 826
425	83 480	690	131 884	691	131 746	1 461	286 639	1 295	306 088
339	93 952	9	2 102	5	734	-	-	41	5 342
99	16 520	585	80 778	670	88 344	1 009	134 365	1 061	145 224
15 352	849 245	23 050	1 136 251	27 108	1 492 005	9 441	1 207 446	9 354	1 169 870
121	14 907	94	9 249	86	12 632	105	9 898	94	12 435
2	314	1	391	1	471	6	1 579	5	2 781
2 502	361 028	3 169	625 260	2 947	579 634	5 395	1 273 585	3 381	768 213
542	145 702	656	156 855	697	180 690	396	205 256	856	234 941
104	20 214	52	10 617	17	4 265	99	21 737	85	14 507
33	11 390	59	20 371	64	22 159	98	35 335	62	19 015
123	13 155	150	12 654	158	11 910	139	12 345	39	7 362
197	39 864	294	45 532	247	44 055	532	98 982	1 180	226 906
450	82 278	957	210 894	607	159 919	773	253 923	855	226 431
1 562	192 843	1 403	124 806	1 333	93 489	1 491	193 507	890	85 313
168	12 748	154	14 330	273	24 415	361	24 106	368	32 795
2 427	310 413	3 585	503 656	4 161	573 110	5 312	916 908	5 987	857 016
656	67 882	816	82 261	927	90 251	1 048	98 281	1 087	102 767
259	53 010	622	166 110	4 427	521 826	1 734	219 185	1 311	191 269
12	3 792	25	7 632	25	8 682	15	4 000	31	8 923
2	562	-	124	7	1 981	6	1 268	6	1 545
3 848	492 180	159	16 449	280	29 742	368	34 530	226	24 462
43	10 648	113	25 208	211	52 387	156	45 726	196	45 188
45	16 305	114	35 863	88	34 569	106	44 850	119	43 534
348	58 408	410	72 194	450	65 064	703	116 391	590	67 468
1	164	-	264	3	783	6	1 235	82	4 088
460	69 358	297	48 453	474	97 215	519	81 003	691	110 888

Description	Tariff code No	1962 Qty	1962 Value	1963 Qty	1963 Value	1964 Qty	1964 Value	1. Qty
D. Metal products (Cont'd)								
Steel furniture - safes, boxes etc ..	738A and B	23	2 664	13	1 694	37	4 555	65
Other furniture (Hospital tables etc)	738A and B	178	16 783	79	10 570	55	8 068	110
Steel wire rope and cranes - chains..	726A,B and C	307	21 330	184	12 654	216	15 735	295
Wire ropes ..								
Steel manufacturers - extruded sheets	735B	385	13 033	335	10 129	551	19 610	508
Other sheet manufacturers ..	754A,B and C	2 492	60 983	2 933	87 562	2 795	81 003	1 589
Other iron and steel manufacturers ..	755A,B and C	682	21 885	879	28 363	1 271	43 550	1 317
Bolts, nuts, rivets and screws ..	728, 729A and B	2 821	116 729	2 453	86 320	1 971	91 099	2 757
Builders' hard ware ..	733 and 734	1 387	99 323	1 210	91 968	1 350	97 120	1 454
Tubing, piping and profiles ..	813	2	440	2	402	1	380	9
Band saw and other saw blades ..	748 and 749	114	19 983	107	21 077	127	25 658	160
Razor blades ..	806B1, B2	90	66 077	104	88 327	118	104 713	109
Tanks and vessels ..	720 and 721	2 899	97 247	743	30 490	936	43 353	1 294
Gas cylinders ..	722	435	21 663	861	34 811	1 109	40 643	1 895
Wire nails and other nails ..	727	2 027	57 312	1 325	43 975	1 137	41 129	777
Other wire products (barbed wire, wire nettings etc) ..	724,725, 753,730, and 731	1 331	50 127	2 275	55 983	2 224	65 935	2 465
Reduction gear ..	N.A.							
Roll and roller bearings ..	856	545	113 136	474	102 590	442	100 929	532
Stoves and parts ..	735A	96	1 774	17	2 499	35	962	46
Kitchen ranges, ovens and parts ..	735B2	79	9 088	271	36 564	400	70 040	206
Electric stoves ..	865A1	29	4 278	39	2 115	131	4 674	30
Sewing machines and parts ..	847	1 016	127 040	1 866	213 799	1 782	218 445	1 710
Typewriters and office machines ..	851,852, 853	128	121 111	98	69 661	160	140 548	256
Parts for the above ..	851-8, 852-6, 853-6	5	2 279	13	8 888	37	9 483	14
Clocks and watches and parts ..		147	86 538	168	85 882	176	29 432	246
Steel drums and containers ..	Nothing - all covered under item 83, tanks and vessels							
Tin cans ..	Nothing - all covered under tin plates and tin sheets under steel imp							
Arc welding electrodes ..	878-2	-	27	-	-	238	17 119	163
Medical and surgical instruments ..	923	159	72 894	216	85 644	185	92 858	417

Source: Foreign Trade Statics of Iran.

SECTION 1

1963		1964		1965		1966		1967		1968	
Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value
13	1 694	37	4 555	65	8 295	49	4 135	6	1 049	11	2 259
79	10 570	55	8 068	110	17 804	228	21 250	185	18 384	139	11 158
34	12 654	216	15 795	295	21 067	411	27 114	617	38 583	718	48 315
335	10 129	551	19 610	508	17 760	493	17 756	748	33 139	504	19 047
933	87 562	2 795	81 008	1 589	64 813	2 434	98 073	2 245	107 448	1 689	98 413
79	28 363	1 271	43 550	1 317	35 040	2 466	55 096	1 869	93 232	2 679	60 827
153	86 320	1 971	91 099	2 757	122 944	3 943	180 919	5 124	205 389	7 552	282 248
210	91 968	1 350	97 180	1 454	146 499	1 461	141 457	1 536	162 535	1 797	196 195
2	402	1	380	9	805	10	993	16	1 152	11	868
107	21 077	127	25 658	160	34 776	142	44 607	175	59 846	179	71 199
104	88 327	118	104 713	109	104 740	159	166 549	280	301 271	169	178 528
743	30 490	936	43 353	1 294	43 394	4 224	196 079	9 983	345 296	7 093	238 019
361	34 811	1 109	40 643	1 895	79 345	2 723	106 054	2 622	96 126	5 054	180 341
325	43 975	1 137	41 129	777	28 700	658	28 488	984	47 013	848	36 371
275	55 983	2 224	55 935	2 465	67 551	2 477	67 013	2 272	66 318	4 002	112 589
474	102 590	442	100 929	532	131 803	697	157 733	811	187 026	781	181 115
17	2 499	35	962	46	829	52	9 057	1	41	1	123
271	36 564	450	70 046	206	30 348	61	11 775	47	10 307	86	14 427
39	2 115	131	4 674	30	1 475	15	858	4	599	28	1 730
366	213 799	1 752	218 445	1 710	205 135	1 878	240 414	1 413	207 734	2 303	320 973
98	69 661	160	160 868	286	212 526	311	280 276	380	311 814	414	288 268
13	8 888	37	9 483	14	5 877	17	5 089	41	45 085	62	38 209
162	25 882	176	29 432	246	43 860	315	61 277	290	59 348	363	110 795
Item 83, tanks and vessels in plates and tin sheets under steel imports											
-	-	238	17 119	163	11 272	176	11 392	55	3 302	201	19 984
216	85 644	185	92 858	417	172 819	401	304 009	154	264 996	397	258 953

SECTION 2

Appendix 4-3

LIST OF IRON AND STEEL IMPORTERS

The following companies import iron and steel for resale. Besides these, there are importers who import iron and steel for their own use. Firms which are contacted for the market survey are indicated by an asterisk.

Name and address	Steel items imported
A. Ordinary steel	
1. Abad Company Ltd 68 Avenue Raphael Teheran	Beams, angles, bars and pipes
2. Afshar Ahmed Passage Hamidein Avenue Nouvarjumehri Teheran	Beams, angles, bars, sheets and pipes
3. Afsharian Hussein Avenue Khayam Teheran	Beams and pipes
4. Badalian Cergin Avenue Khatan 283 Teheran	Sheets, plates and cast iron pipes
5. Barsimat K & Co.* Sorayo Nasi Teheran	Beams, bars, angles, sheets and pipes
6. Damodar Company* Sorayo Saffari Teheran	Beams, bars and sheets

Appendix 4-3 (continued)

Name and address	Steel items imported
A. Ordinary steel (cont'd)	
7. Farhang and Germanian Co. Seraye Razi Teheran	Beams, sheets and pipes
8. Gorashi Mohamed* Seraye Razi Teheran	Beams
9. Haddad Zadeh Asghar* Bazar Ahangarha Kalaye Ahan Teheran	Beams, angles, sheets and pipes
10. Haji Baba Ali Akbar Bazar Ahangarha Teheran	Beams and bars
11. Hamadani Qassem Hamadani Building Avenue Nousarjumehri Teheran	Beams, angles, bars, sheets and pipes
12. Iran Metal Co.* Avenue Panzdar Teheran	Beams, angles, sheets and pipes
13. Keyvanian Trading Co.* Seraye Chartear Teheran	Beams, angles, bars, sheets and pipes
14. Kohli Trading Co.* Bank Sepah Building Teheran	Beams, angles and bars
15. Kyanoo Trading Co.* Seraye Razi Teheran	Beams, angles, bars, sheets and tubes
16. Nasval Company Limited Passage Ferdousi Avenue Ferdousi Teheran	Beams, angles, bars, sheets and pipes

[redacted]

Appendix 4-3 (continued)

Name and address	Steel items imported
A. Ordinary Steel (cont'd)	
17. Hudbah Company Ltd. Sevagh Isavan Teheran	Sheets and pipes
18. Mansour Company Ltd Sevagh Nour Nasar Kaffashaha Teheran	Pipelet
19. Mohammad Ismail* Pallah Zadeh Sevagh Iani Teheran	Beams, bars etc
20. Mohammad Taghi Farhang* Sevagh Iani Teheran	Beams and bars
21. Mihan Company* Passage Mirpour Avenue Nasserjumshari Teheran	Beams, angles, bars, sheets and pipes
22. Nashirvani & Co.* Sevagh Iani Teheran	Beams, angles, bars, sheets and pipes
23. Pars Pulley Co. Sevagh Haji Ghasem 15 Teheran	Beams, angles, bars, sheets and pipes
24. Pars Steel Co. Sevagh Khana Teheran	Beams, angles, bars, sheets and pipes
25. Saadat Ali & Co.* Sevagh Iani Teheran	Beams, angles, bars, sheets and pipes
26. Salehiands & Co.* Sevagh Iani Teheran	Beams, angles, bars, sheets and pipes

[redacted]

[redacted]

[redacted]

[redacted]	[redacted]
[redacted]	
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

Appendix 5-1

INDUSTRIES VISITED AND AGENCIES INTERVIEWED FOR FIELD SURVEY

	Industry	Location	Products manufactured
A.	**Transport equipment**		
1.	British Leyland Motor Corporation	Teheran	Diesel engines
2.	Deutz Bus	-do-	Buses and minibuses
3.	Iran Industrial Autobus Manufacturing Consortium	-do-	Buses and mini-buses
4.	Iran Muffler	-do-	Exhaust system
5.	Iran National Industrial Manufacturing Co.	-do-	Passenger cars, buses and minibuses
6.	Iran Peyma	-do-	Buses and minibuses
7.	Layland Motor Iran Company	-do-	Trucks
8.	Moratab Ltd	-do-	Land rovers
9.	Pars Lux Industries	-do-	Buses and minibuses
10.	Sahami ye Citroen	-do-	Passenger cars
11.	Sharikate Sahami Jeep	-do-	Passenger cars and jeeps
12.	Sharkate Sahami Towlidi Fanar	-do-	Laminated and coil springs
13.	Sharkate Sahami & Shanthiye Kaveh	-do-	Trucks
14.	Pars-Volvo-Iran National Auto Spring Manufacturing Company	-do-	Autosprings
15.	Volvo Trucks	-do-	Trucks

Appendix 5-1 (continued)

Industry	Location	Products manufactured
B. Electrical equipment		
1. Ali Nassab Factory	Teheran	Refrigerators, water coolers, water heaters etc
2. Arz Corporation	-do-	Refrigerators, water coolers, water heaters etc
3. English Electric Company	-do-	Electric equipment
4. General Electric Iran	-do-	Refrigerators
5. General Industrial Company	-do-	Electrical appliances
6. Iran Transfo	-do-	Transformers
7. Nepto Electric Industries	-do-	Electrical appliances
8. Philver Manufacturing Company	-do-	Refrigerators, evaporation coolers etc
9. Sharkate Sanatiye Asmayesh	-do-	Water coolers, radios etc
10. Siemens Ltd	-do-	Transformer, switch gear and contact gear etc
11. Zagross Refrigerator	-do-	Refrigerators
12. Zah Company	-do-	Electrical appliances
C. Industrial and agricultural machinery		
1. Arak Machine Building Project	Teheran	Agricultural machinery, cranes, conveyors, boilers and ancillary equipment
2. Arak Machine Building Plant	Arak	
3. Asad Machinery Manufacturing Co	Teheran	Tea processing machinery

Appendix 5-1 (continued)

Industry	Location	Products manufactured
C. Industrial and agricultural machinery (cont'd)		
4. Cater Pillar	Teheran	Earthmoving machines (service and sales only)
5. Deltaker Corporation	-do-	Concrete mixers, dumpers etc
6. Dorman Diesel	Tabriz	Stationary diesel engines
7. General Mechanic Engineering Co	Teheran	Constructional machinery
8. Iran Abzar	-do-	Shovels, wheel barrows etc
9. Iran Compressors	-do-	Dumpers, Scrapers etc
10. Iran Diesel Engine Manufacturing Company	-do-	Diesel engines
11. Karkhane Doghat	-do-	Tile making machines, hammers etc
12. Karkhane Sakkaki	-do-	Carpentary machinery, bending machines etc
13. Luleh Va Machine Sazi Iran Co	-do-	Machine manufacturing
14. Machine Sazi	Tabriz	Machine tools, compressors, pumps etc
15. Skoda Irano Company	Teheran	Earthmoving machines (service and sales only)
16. Tabriz Metallurgical & Engineering Project	-do-	Machine tool, presses etc
17. Technois		Constructional machines and equipment

Appendix 5-1 (continued)

Industry	Location	Products manufactured
C. Industrial and agricultural machinery (cont'd)		
18. Telima Company	Teheran	Concrete mixers, dumpers etc
19. Tractor Sazi	Tabriz	Tractors
D. Metal products		
1. Aderal Domestic Appliances Co (persigas)	Teheran	Hotplates, cooking rates and stoves
2. Ahwas Pipe Mill	Ahwaz	Pipes
3. Ahwas Rolling Mill		Sections, beams etc
4. Alladin Industries	Teheran	Stoves
5. Asari Tank Factory	Teheran	Tanks for oil and water
6. Bootan Gas		Gas ranges, gas c/linders and hot plates
7. Cyrus Arumand		Tank structures etc
8. Donaye Pelas		Profiles
9. Electro Asa		Welding electrodes, grinding wheels, G.I. wires, annealed wires etc
10. General Gas Company		L.P.G. cylinders
11. Guiver Profile Manufacturing Co		Tanks for oil and water
12. Hefas Manufacturing Co.		Metal furniture
13. Iran Metal Works		Metal furniture
14. Karkhanejate Ojagheges Ltd		Cookers, hot plates and cylinders

Appendix 5-1 (continued)

Industry	Location	Products manufactured
D. Metal products (cont'd)		
15. Kaveh Industrial Group Inc.		Welding electrode, furniture, safes etc
16. Khamenei Metal Box Company		Tincans
17. O.K. Electrode Manufacturing Co		Welding electrodes
18. Paramar Co.		Razor blades
19. Parsnails Manufacturing Co.		Nuts and screws
20. Pars Metal		Tubes, joints, parts for various machinery etc
21. Peech Va Mohreh Iran Ltd	Teheran	Nuts and bolts, doors and windows etc
22. Sahapasand Oil Company		Tincans
23. Sepanta Manufacturing Company		Tanks for oil and water
24. Sharkate Arrey		Hacksaw blades
25. Sharkate Calorigas		Gas ranges
26. Sharkate Sahami Tawlieli Finat		Profiles
27. Speed Company		Metal furniture
28. Teheran Kar		Metal furniture
29. Tedeo Company Ltd		Stoves
E. Other concrete units		
1. [illegible] Iran Company	Teheran	Contractors and manufacturers of pre-stressed concrete
2. General Construction Company		Contractors and consultants

Appendix 5-1 (continued)

	Industry	Location	Products manufactured
	E. Other economic sector (cont'd)		
3.	Iran Pay Ltd		Contractor
4.	Iranian Rolling Mills		Bars and rods
5.	National Iranian Gas Company	Teheran	-
6.	National Iranian Oil Company		Oil, gas, petrochemical, tincans and pipes
7.	National Iranian Steel Corpn		-
8.	National Petrochemical Company		Petrochemicals, fertilisers etc
9.	Navid & Company		Contractors
10.	Nurroh Company		Contractor
11.	Steel Plant	Isfahan	-
12.	Tecna & Company	Teheran	Contractor

F. Government authorities and private consulting

1. Bank Markazi
2. Industrial Development and Reconstruction Organisation
3. Industrial and Mining Development of Iran
4. Iranian State Railways
5. Ministry of Economy
6. Ministry of Economy, Directorate General of Industries
7. Ministry of Economy, Research Centre
8. Ministry of Economy, Statistical Bureau
9. Ministry of Water and Power

Appendix 5-1 (continued)

E. Government authorities and private agencies (cont'd)	Location	Products manufactured

10. Plan Organisation

11. Rezai Brothers

12. Small Scale Industries and Industrial Estate of Iran

Investigator's code .....

Appendix 5-2

QUESTIONNAIRE ON [illegible] STEEL DEMAND IN 1968

SECTION 1

I. Name of organisation:
Address:

Telephone No:

II. Please indicate the products manufactured by you which consume tonnage steel (other than alloy or special steels) giving the annual capacity of your works in terms of quantity (tons, numbers, km, MW, MVA etc).

Name of product	Working hours/day	Capacity 1968 (1344) Quantity	Value	1968 (1347) Quantity	Value	1969 (1348) Quantity	Value
1.							
2.							
3.							
4.							

III. Do you have any expansion programme - Yes/No

Please indicate the capacity in future:

Name of product	working hours/day	Capacity 1971 (1350) Quantity	Value	1972 (1351) Quantity	Value
1.					
2.					
3.					
4.					

IV. Please give the actual production figures of your products for the years 1965, 1966, 1967 and 1968 and, if possible the planned production for the year 197[illegible] in terms of quantity and value.

Name of product	1965 (1344) Quantity	Value	1966 (1345) Quantity	Value	1967 (1346) Quantity	Value	1968 (1347) Quantity	Value	1972 (1351) Expected Quantity	Value
1.										
2.										
3.										
4.										

V. If you are not working to full capacity now or earlier, please indicate reasons for the same.

1.
2.

IV. Please give the actual production figures of your products for the years 1965, 1966, 1967 and 1968 and, if possible, the planned production for the year 197[illegible] in terms of quantity and value.

Name of product	1965 (1964) Quantity	1965 (1964) Value	1966 (1965) Quantity	1966 (1965) Value	1967 (1966) Quantity	1967 (1966) Value	1968 (1967) Quantity	1968 (1967) Value	1972 (1951) Expected Quantity	1972 (1951) Expected Value
1.										
2.										
3.										
4.										

V. If you are not working to full capacity now or earlier, please indicate reasons for the same.

1.
2.
3.
4.

VI. We want to find out the quantity of tonnage steel required by you for each of your products. The quantity should include the process scrap generated during manufacture. Kindly indicate the following:

Name of product	Unit of production	Steel required in gg per unit of production: Ingots	Non-flat products	Flat products	Tubes and tube fittings	Total quantity
1.						
2.						
3.						
4.						

VII. Please indicate by tick mark (✓) which of the following product categories of tonnage steel you need. If you use any other product category please mention that category.

a. Ingots
   1. Ingots
   2. Blooms, billets, slabs or sheet bars

b. Non-flat products
   1. Rounds
   2. Channels
   3. Equal angles
   4. Unequal angles
   5. Tees
   6. Other shapes
   7. Round bars
   8. Square bars
   9. Flat bars
   10. Wire rods
   11. Rail sleepers
   12. Rails
   13. Wheels, tyres and axles
   14. Wires

Appendix 5-a

SECTION 1

a. Flat products

1. Plates
2. Hot rolled sheets
3. Cold rolled sheets
4. Galvanised sheets
5. Tin plates
6. Coated sheets (other than tinned or galvanised)
7. Electrical steel sheets
8. Hot rolled strip
9. Cold rolled strip
10. Skelp
11. Hoop

b. Steel tubes and fittings

1. Seamless tubes
2. Welded tubes (all types)
3. Steel tube fittings

c. Steel forgings

d. Steel castings

VIII. Do you use tonnage steels for any other uses besides manufacturing?

Name	Product category	Quantity required per year, in tons

IX. Please indicate the total consumption of tonnage steel giving the product category (as listed in question VII) and sizes in the year 1966 (1967). Finally also indicate the likely consumption.

Product category	Size ranges		Consumption in tons	
	From mm	To mm	1966	1972 expected

X. What is the quantity of your supplies from domestic, direct import and through importers?

XI. Finally indicate which standard specifications you normally follow in your requirements of steel.

American/British/German/Japanese/Russian/Swedish/Italian/French

XII. Did you get your full requirements of steel in 1966?

Requirement tons	Consumed tons

[redacted] [redacted] expected

V. What is the quantity of your supplies from domestic, direct import and through importers?

VI. Kindly indicate which standard specifications you normally follow in your requirements of steel.

American/British/German/Japanese/Russian/Swedish/Italian/French

VII. Did you get your full requirements of steel in 1968?

Requirement tons	Received tons

If you did not get full quantity of your requirements, please indicate the reasons therefor.

VIII. How much steel did you [redacted] in the year of 1967 and 1968?

IX. How much foreign steel are you likely to import annually in the next few years?

	Anticipated requirement tons/yr	Increase over 1968 requirement
1969	(1300)	
1970	(1300)	
1971	(135)	
1972	(1351)	
1973	1354	

X. Name of the person filling this questionnaire .....

Department : .....

Designation : .....

Date : .....

Appendix I (continued)

Investigator's code .....

[redacted]

1. [redacted]

2. [redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	1978 (12m) [redacted]
1.					
2.					
3.					

4. [redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
1.					
2.					
3.					

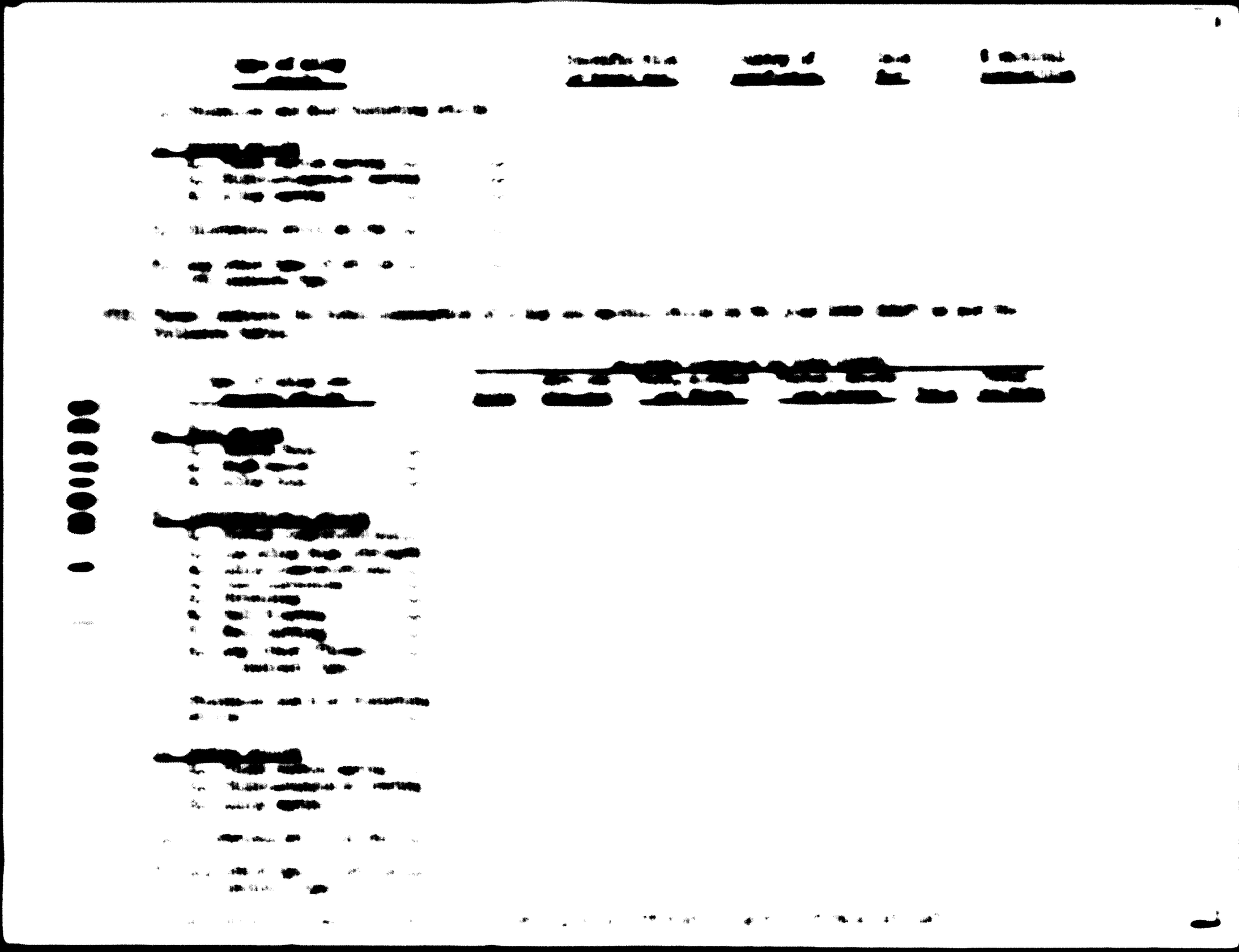
5. [redacted]

[redacted]	[redacted]	[redacted]	[redacted]
1.			
2.			
3.			

6. [redacted]

[redacted]

[redacted]



Appendix E-8 (continued)

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SECTION 1

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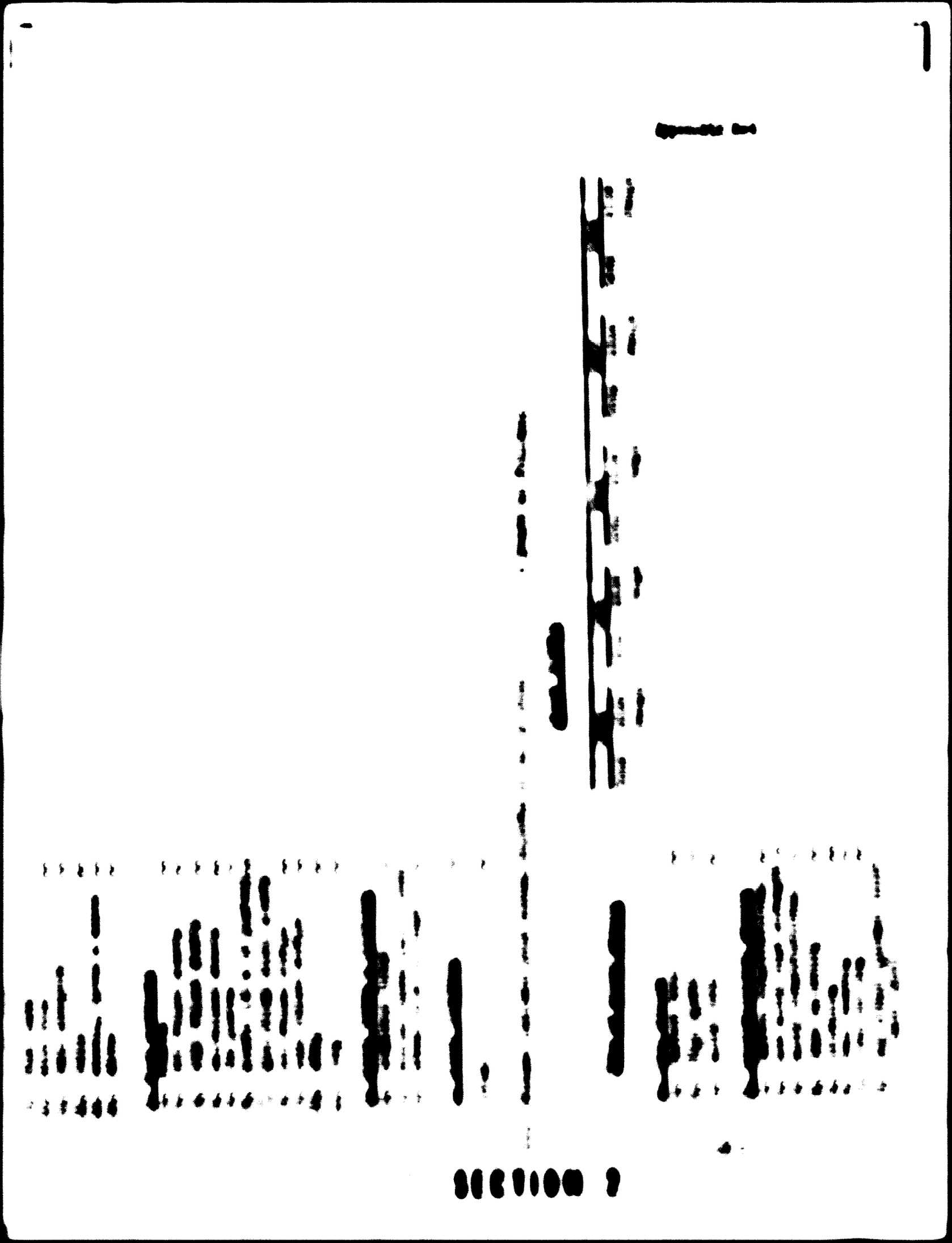

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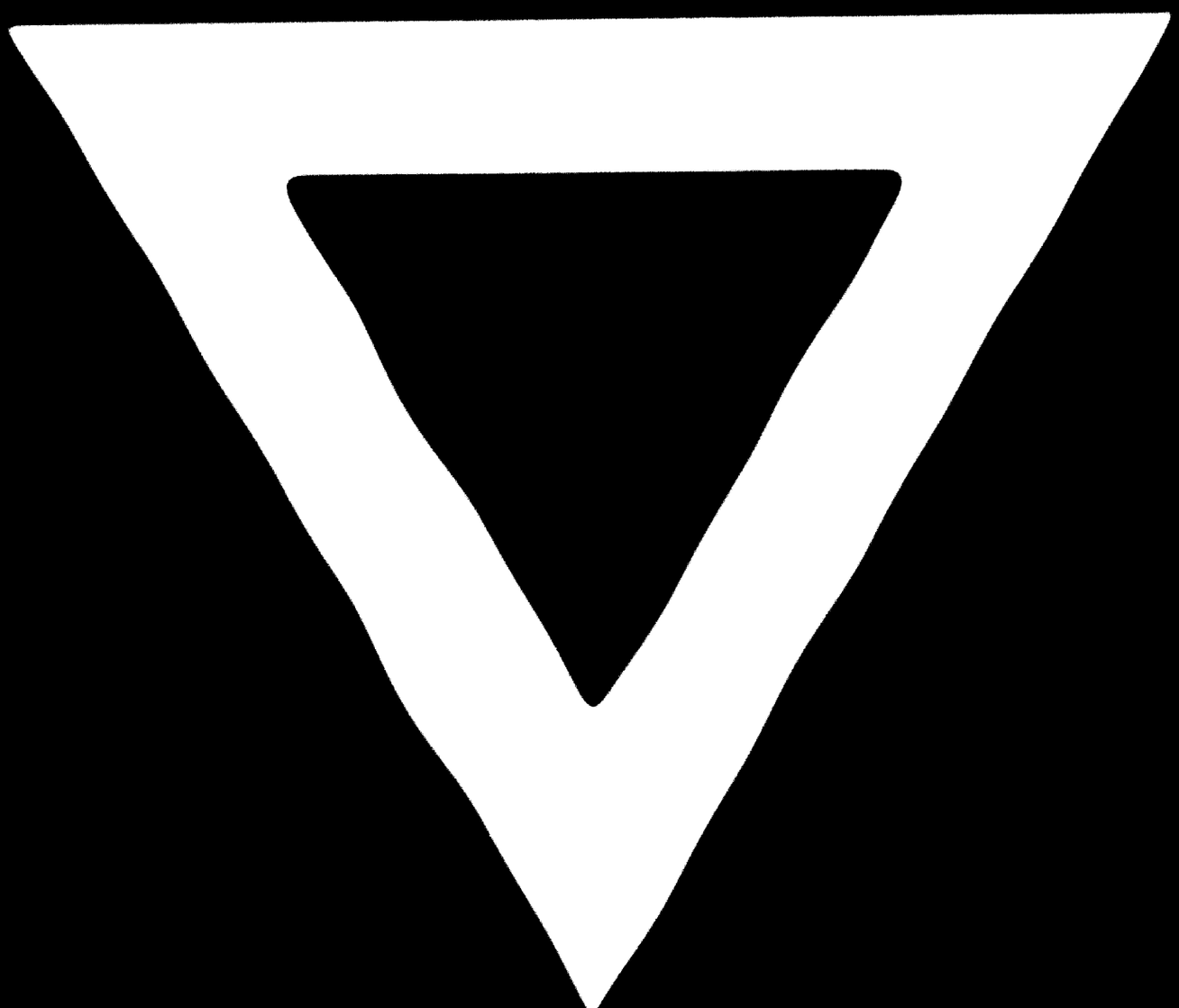

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