EXECUTIVE SUMMARY

0.1 BACKGROUND

Wire drawing is an import industry playing a significant role in the development of society. Wire is fabricated into thousands of different kinds of articles, which are used for a great variety of purposes. The common use of steel wires are as automobile and bicycle spokes, hoops, rivets, bolts, chains, buckles, wire rope cotter pins, screws, wire netting, wire cloth and a host of others. The non ferrous wires such as copper and aluminium are used in motors, transmission of electricity, transformers, domestic wiring etc. The sophistication achieved by the industry has been remarkable during the last two decades and the industry has been successful in achieving a product range of various types of high carbon, alloy steel and special steel wires. The versatility has been achieved by the industry for meeting the requirements from pins to atomic power projects, from prestressed concrete to energy transmission and telecommunication. This sophistication has been possible due to continuous and well planned R & D efforts on the part of the manufacturers.

The country is now producing a number of wire drawing machines in collaboration with the leading wire drawing machinery manufacturers from France, U.K., Germany and Japan. Some of the wire drawing equipments manufactured in the country are wire flattening mills, stranding and closing machine for manufacture of wire ropes, rod breakdown machines, intermediate fine and super fine wire drawing machines for ferrous and non ferrous wires. Certain kinds of wire drawing machines are also being exported from the country.

0.1.1 Types of Wire Drawing Machines

There are several types of drawing machines. These have been grouped as follows :-

- Drawing frames
- Bull blocks, & motor block
- Multiple-drawing machines
- Fine-wire machines
- Turk's - head shaped - wire drawing machines
- Drawbenches.

0.1.2 Auxiliary Equipments of Wire Drawing Machines

The auxiliary equipments to be attached with wire drawing machines consist of pay off reels, safety stop, welders, pointer, straightening and cutting machines, rotary straighteners, and roll straighteners etc.

0.2 STRUCTURE AND STATUS OF IADIAN INDUSTRY

At present there are three leading manufacturers of Wire Drawing Machines in the organised sector in India. There are few other manufacturers, in the small scale sector. Most of these manufacturers, fabricate wire drawing machines alongwith other machinery. It is therefore difficult to estimate the installed capacities in this particular sector.

LICENSED AND INSTALLED CAPACITIES OF WIRE DRAWING MACHINES

Type of Machinery	No. of Plants Registered	Total Capacity (No. of Machines/annum)	
		Licensed	Installed
Wire Drawing Machines	3	350	290
Wire Stranding Machines	3	60	50

Further this industry is now delicensed, providing potential to manufacturers of other machines to diversify into the manufacture of wire drawing machines.

0.3 PRODUCTION

As per DGTD annual reports, the organised sector production in the past three years was as under :-

Year	Annual Production (Rs. lacs.)
1989-90	1271.91
1990-91	1692.54
1991-92	1740.85

Besides there are 46 manufacturers in the small scale sector. The annual production in small scale sector from 1989-90 to 1991-92 is given as under.

Year	Annual Production (Rs. lacs.)
1989-90	681.74
1990-91	823.64
1991-92	944.60

0.4 EXPORTS

The wire drawing machines are exported in substantial quantity. The export in last three years was as under :-

Year	Amount (Rs. lacs.)	No. of machines
1988-89	77.50	463
1989-90	82.40	476
1990-91	171.94	861
1991-92	241.62 *	976 *

Notes : - * Estimated.

0.5 PERFORMANCE OF THE INDUSTRY

The companies manufacturing wire drawing machinery are mostly manufacturing other machines also, and hence the annual reports of these companies do not reflect the performance with regard to the production of wire drawing machines. The annual production and sales of wire drawing machines of most of the leading manufacturing companies is however, found to be increasing every year.

0.6 DEMAND ASSESSMENT OF WIRE DRAWING MACHINERY

The total wire drawing machinery requirement is worked out as under :-

(Fig. in Rs. lacs.)

Sl. No.	Year	Steel wire drawing Machinery	Copper wire drawing Machinery	Aluminium wire drawing Machinery	Other wire drawing Machinery @ 10% of 2,3 & 4.	Require-ment for export	Total require-ment of wire drawing Machinery
1.	1993-94	3090	413	680	418	226	4827
2.	1994-95	3360	446	756	456	260	5278
3.	1995-96	3630	524	841	500	299	5794
4.	1996-97	3900	568	960	542	344	6314
5.	1997-98	4200	615	1043	585	395	6253
6.	1998-99	4560	667	1159	638	454	7478
7.	1999-2000	4920	722	1290	639	523	8148

These estimates are based on past trend method. The growth in indigenous demand is estimated at 7.85% p.a. and the growth in export demand is estimated at 15% p.a.

0.7 TECHNOLOGY STATUS OF THE LEADING INDIAN WIRE DRAWING MACHINERY MANUFACTURERS

There are three leading manufacturers manufacturing wire drawing machines. Besides there are a number of manufacturers in small scale sector who manufacture wire drawing machines mostly suitable for drawing of different wires in thick guages, Super fine wire drawing machines are not manufactured in the country for drawing of wire beyond 40 SWG diameter in both ferrous and non ferrous metals.

0.7.1 Usha Martin Industries Ltd.

Its Machinery Division, started originally with technical Collaboration from M/s Marshall Richards Barcro of U.K., who pioneered many developments in wire drawing machinery such as Double-bloc"BB" machines, Straight through Pathfinders, and Dancer arm Pace-makers. It entered into several other licensing, agreements with reputed European manufacturers as follows :-

Hi-Draw, U.K.

- De Angeli Spa, Italy.
- Stolberger Maschinenfabrick, Germany.

The annual exports of the company of its machinery to different countries was as under :-

YEAR	COUNTRY	VALUE IN US $
1984	THAILAND	285,000
1985	THAILAND	4,500
	YUGOSLAVIA	275,875
	NEPAL	50,820
1987	THAILAND	18,100
1988	THAILAND	219,000
	YUGOSLAVIA	57,500
1989	THAILAND	207,260
1990	THAILAND	97,350
1991	MALAYSIA	43,500
	TOTAL	**1,258,905**

The company currently manufactures following machinery:-

- Wire Drawing Machines and allied equipment
- Stranding and closing machines for manufacturing of Wire Ropes
- Plant and equipment for the manufacturing of Telephone Cables
- Wire Flattening Mills
- Copper coating lines for CO_2 welding wire manufacture
- Low Relaxation lines for PC Wires and Strands
- Material handling equipment like vehicle mounted Winches; Wagon haulers.
- Power plant spares for large thermal power plants.

The machinery division's emphasis from its inception has been on product development and design, to offer the best in wire processing machinery to meet customer's specific requirements. The Division over

the years has established good design capabilities including computer aided design.

0.7.2 The Aluminium Industries Ltd.

The Aluminium industries Ltd., started with initial technical collaboration with M/s Miyazaki Iron Works Ltd., Osaka Japan and subsequently entered into collaboration with M/s Takashima Sangyo Co. Ltd., Japan, M/s MMC Brondel, France, & M/s Firth Brown Castings Ltd., U.K.

The company's well equipped machinery division has a foundry, designed and built to Japanese standards, for making close grained quality castings weighing up to 10 tonnes a piece. Fabrication and heat treatment shop having presses, rolls, cutting and welding machines and a machine shop with a variety of machine tools.

The range of wire drawing machines being manufactured by the company are as under :-

- Block type wire drawing machines for ferrous and non-ferrous wires.
- Rod breakdown, intermediate, fine and super fine wire drawing machines for ferrous & non-ferrous wires.
- Tubular Stranding Machines (Under roller and Encircling bearing type.)
- Rigid stranding machines.
- Planetary stranding machines.
- Cable Laying up machines.
- Pairing / Bunching machines.
- Rigid / Planetary Armouring machines.
- Telephone Cable drum twisters.
- Power Cable drum twisters.

- Straightening and Cutting machines.

- Telephone cable making machines.

- Low relaxation PC Line, Tyre Bead Wires etc.

- Accessories, viz. spoolers, coilers, takeup stands, pointing and threading machines, pay offs, brushing and descaling units, rewinding machines etc.

The company has exported various types of machines worth Rs. 200.00 lakhs to South East Asian Countries, Baharin, Sri Lanka, Nigeria, Kenya, Thailand, Malaysia, Pakistan and Bangladesh etc.

0.7.3 Allied Machinery Corporation

Another leading manufacturer is Allied Machinery Corporation. The company's plant is located in the industrial area on the outskirts of Ghaziabad near Bulandshahar Road. It manufactures machines for the production of a variety of wires in various dimensions materials capable to be drawn - from bull block to fine wire drawing machines. The company do not have a foreign technical collaboration. The technology being used is all indigenous and developed by the company itself.

The types of equipments manufactured by the company are as under :

a. Dry Drawing

- OTO and accumulation type machines (12 mm- 0.7 mm)
- Double blocks (B.B. Types)
- Straight line wire drawing machines
- Bull blocks - (26 mm - 8 mm)
- Draw benches.

b. Set Drawing

- Wet wire drawing machines (3 mm-0.12 mm)
- Rod break down machines.

c. Accessories

- Pay offs/Bundle binders
- Spoolers / Take-ups Rewinding lines

- Butt Welding Machines
- Wire Pointing machines & Threading Machines
- Die lopping machines
- Dead block coilers.

0.7.4 Structure of The Small Scale & Ancillary Industry

There are a large number of machinery manufacturers in the small scale sector, who manufacture wire drawing machinery alongwith other machineries. The leading small scale manufacturers are :

i) Ashoka Enterprises (P) Ltd.
New Delhi - 110 024

ii) Ram Industries,
Haryana

iii) New Bishal Akshams Engg. Works,
Howrah

iv) International Machine Tools Corporation,
Bombay

v) Surendra Engg. Works,
Calcutta

vi) D.G. Virdi & Sons,
Ghaziabad

vii) G.S. Industries,
New Delhi

viii) Ganga Singh & Sons,
Rewari

ix) Wire Machinery Mfg. Corporation,
Calcutta

x) Hind Engineering Co.,
Howrah

xi) K.B. Machine Factory,
Amritsar

xii) Assomac Machines (P) Ltd.,
Ghaziabad

xiii) Malik Engineering Works,
Noida, Ghaziabad.

Some of the above companies have also exported their machines for small scale steel wire drawing plants, which are running successfully.

0.8. INTERNATIONAL SCENARIO IN WIRE DRAWING MACHINES

Number of developments have taken place with regard to quality and types of wire being produced for different use besides substantial increase in the speed with which the wires are being produced using different types of machines and automation in process by using computers. Continuous research and development by different leading companies in U.S.A., Japan, Germany and U.K., have led to the development of newer wire drawing machines such as slip type machines, auxiliary equipments such as bundle packers with continuous operation, automatic packing machines, etc. The recent developments abroad are as under :-

0.8.1 Drawing, Annealing and Spooling Line for 12 Wires

Mac Raw Inc. USA has introduced a combined drawing annealing and spooling line for 12 wires. This wire drawing unit is composed of a drawing machine, an annealer and a spooler. The drawing machines, fitted with 28 dies, makes possible to draw 12 wires simultaneously. The maximum wire inlet diameter is 1.80 and 2.00 mm respectively, the finished diameter ranges from 0.10 up to 0.30 mm.

0.8.2 Dtha Series In-Line Drawing Machines

A DTHA in-line drawing machine, developed by Fasteners Engineers USA helps increase productivity, improve parts control and eliminate high maintenance costs.

The machine is designed to provide ease of operation. Once this machine is set up in a production line, it requires no operator control or monitoring.

0.8.3 CNC Controlled Drawing Die Working Machines

Will Premier Germany has recently introduced a CNC controlled drawing die working machine.

This NC drawing die working machine is an improved version of the field-proven old model.

The drawing die is measured fully automatically using state-of-the-art computer technology and built-in electronics, the relevant NC programme is then called up to start the automatic work cycle. The system checks the bore diameter continuously over the whole work cycle which ensures very close tolerances for radius and bore diameters.

0.8.4 Multiwire Drawing Line with Robotic Spooler

Sictra Srl, Italy has introduced a multi wire drawing line with robotic spooler. The specification of the model TFE is as under :-

Max. inlet copper wire (mm)	2 X 8	
Minimum outlet (mm)	0.50 X 8	
Maximum outlet (mm)	0.20 X 8	
Max no. of drafts per wire line	:	21
Standard wire elongation per die	:	21% or 24%.

0.8.5 Superfine Wire Drawing Machine for Copper and Precious Metal Wires

Machinen Fabrick Nicholt GmbH, Germany has developed a super fine wire drawing machine for drawing copper and precious metal to make wires in finishing dia of 0.012 to 0.05 mm. the features of the machine are as under :-

Inlet diameter	Max. 0.12 mm
Finish diameter	Min 0.012 mm
Finish diameter	Max. 0.05 mm
Wire elongation	6.10 or 12% per draft
Number of draft	14, with one pair of cones

0.8.6 New Slipping Wire-Drawing Machine

A new slipping wire drawing machine has been developed by Team Macannica srl, Italy. The new Slipping wire drawing machine with

submerged cones was developed for the drawing of steel wire with low and high carbon content. Also wire of galvanized steel brass coated steel for steel-cord and house-wire as well as copper coated steel for CO_2 welding wire can be drawn.

The machine is driven by D.C. or A.C. motors with frequency control. The power range extends from 22 to 90 kw allowing a production speed of upto 25 m/s. With this machine four wires can be drawn at the same time. The machine works with two or four cones, the drawing process can be realized on 9 to 23 passes.

0.9. R & D EFFORTS

R & D efforts are being made by the wire drawing machinery manufacturers for the development and upgradation of the wire drawing machines. R&D efforts have been made to indigenise the machines by Usha Martin Industries Ltd., and The Aluminium Industries Ltd., R&D establishments are as under :

0.9.1 Usha Martin Industries Ltd., Bangalore

The company has full fledged R & D facilities and is continuously indigenising and developing different machines. It introduced, for the first time in India, a series of Dancer bloc and line bloc wire drawing machines. These are non slip, non accumulation type continuous wire drawing machines.

The company's R&D has helped gauge technical development trends taking place elsewhere in the world, with regard to productivity, improvement, energy conservation and environmental protection etc.

0.9.2 The Aluminium Industries Limited

The company's in-house R&D facilities have helped in indigenisation of a number of wire drawing machines. Its R&D has been successful to the extent that improvements and modifications upon original Miyaszaki designs have been made have been made.

0.9.3 R & D Efforts by Research Institutions

There has been no research institute exclusively for the wire drawing industry. The various research organisations connected with this industry are :

- National Metallurgical Laboratory, Jamshedpur.
- Central Mechanical Engineering Research Institute, Durgapur.
- Defence Metallurgical Research Laboratory, Hyderabad.

Till date,no significant development efforts for the wire drawing industry by these institutions has been made.

0.10 TECHNOLOGY ABSORPTION EFFORTS

The technology for the manufacture of wire drawing machines is about 25 years old. The basic technology was imported from Miyaszaki Iron Works Ltd., Japan, Takashimo Sangyo Co. Ltd., Japan, MMC Brondel France,Firth Brown Castings Ltd., U.K., Tosef Mali V. Bruder Austria, Marshall Richards Barcro of U.K., Hi-Draw Machines Ltd., U.K., De Angeli Spa Italy, Stol Berger Maschinen Fabrik, Germany etc. The R&D efforts of the Indian Companies having collaboration with the above leading wire drawing machinery manufacturers led to the indigenous development of these machines. While such basic research has been undertaken for upgradation of technology by both Usha Martin Industries and Aluminium Industries Ltd., but, most of the efforts have been towards absorption and adaptation of the technologies imported from their respective collaborators.

0.11 TECHNOLOGY GAPS IN WIRE DRAWING MACHINES

The machines have been divided broadly into following groups :

- Bull Block machines
- Heavy duty rod break down machines
- Intermediate wire drawing machines
- Fine wire drawing (heavy wire sections)

- Fine wire drawing machines (Light wire sections)
- Super fine wire drawing machines.

0.11.1 Bull Block Machines

A comparison of technical specifications of the German, Italian and American machine indicates that all manufacturers provide multi speed machines in this range, whereas most of the bull block machines available in India are single speed.

Further the foreign manufacturers offer bull blocks with directly coupled motors. It appears that due to the non-availability of heilcal bevel gear (crown gear) most of the Indian suppliers cannot offer a directly coupled motor.

0.11.2 Rod Breakdown Machines

In case of rod breakdown machines those upto 40 meters per second are available from abroad. In comparison to high speed foreign machines Indian machines are slower having speeds upto 20 meters per second. They also employ a low weight take up spool. The choice of selection is also relatively restricted.

0.11.3 Intermediate Wire Drawing Machines

Most of the foreign manufactures offer machines of different wire elongations output and types of drives. Take up spools upto 1000 kg and process speeds upto 70 meters per second are offered. Most of the foreign suppliers use d.c. drive with thyristor control, the Indian manufacturers, leaving a few, offer slip ring motors. The motor hose power of Indian manufacturers is also substantially low.

0.11.4 Fine Wire Drawing Machines

As in the previous case the Indian Fine Wire Drawing Machines are of relatively low speed and allow a lot takeup weight.

0.11.5 Super Fine Wire Drawing Machines

A comparison of super fine wire drawing machines is given below :-

TECHNICAL SPECIFICATIONS OF SUPERFINE WIRE DRAWING MACHINE

Description	German manufacturers	British manufacturers	Italian manufacturers	Indian manufacturers
Input diameter (mm)	0.12	0.15	0.2	0.3
Output dia, range (mm) Wire elongation (%)	04-0.012 6 to 10 variable	0.06-0.02 10 to 10/6 or 15/7.2	.08-0.0125 8.7/11.1	0.100
% Area reduction	5.6 to 9.1 variable	9.1 or variable from 9.1/5.6 or 13/7.7	6.5/8/10	6.6%
No. of drafts	16	20	-	13
Speed max (M/Sc)	21	25	-	15

There are only few companies in the world manufacturing superfine wire drawing machines. In these machines heavier reductions are given in the initial dies, whereas lower reductions in the region of 5.6 percent are given in subsequent dies. Machines with constant area reduction are also available. Indian manufacturers need to develop superfine wire drawing machines preferably in wire drawing of above 35 swg.

0.11.6 Wire Drawing Allied Machinery and Accessories

The first and foremost important area is the take up reel. The take up reel of a wire drawing machine operation influences the productivity. A large take up weight not only improves the productivity of drawing machines but also improves productivity in subsequent operations. It also reduces the scrap at every stage of production. Hence machines capable of handling large take up spool weight needs to be developed to improve productivity and quality of wire drawing machines and end products.

Most of the foreign manufacturers offer ceramic, tungsten carbide or flame coated capstan rings. In contrast the Indian manufacturers offer only hardened and heat treated alloy steel capstans. Wear of these rings is much faster.

0.12 CONCLUSIONS

0.12.1 Wire drawing like any cold working of metals such as iron, copper or aluminium increases the hardness, stiffness and elastic limits. The results attainable by the wire drawing process are summarised as under :-

i. Metal may be elongated and reduced in section to an extent not attainable by other methods.

ii. A greater degree of accuracy as to the size and section can be attained that is not possible by other methods.

iii. A uniformly smooth and highly polished surface can be produced.

0.12.2 While steel wire is fabricated into a number of wire products, the copper and aluminium wires are mainly used as winding wire in electrical applications. Keeping in view the use of wire to manufacture a number of products, use of wire drawing plants is continuously increasing in the country and abroad. In fact, the wire drawing process and technology are getting so advanced that use of computer aided process control is finding an integral part of wire drawing plant.

0.12.3 India is now producing a large variety of wire drawing machines starting from block machines to intermediate rod breakdown machines and fine wire drawing machines suitable for drawing of both ferrous & non ferrous wires. These machines are manufactured by different manufacturers in collaboration with leading wire drawing machinery manufacturers from France, U.K., Germany and U.S.A.

0.12.4 Most of the equipment manufacturers in the country in the organised sector, have collaboration with the leading manufacturers in the world. The companies having collaboration are regularly updating the technology being developed by their collaborators. However, in some cases such as use of computer in process control, use of multi-drawing machines, use of light pressure lubrication system in dry-drawing etc. are not being adopted because such sophistication might not be insisted upon by the users. It is however necessary to update the technology in order to step-up the exports of the wire drawing machinery.

0.12.5 A large production of wire drawing machines exists in the small scale sector, which is contributing about 35% of the total wire drawing

machines requirement in the country. This sector contributes to manufacture of wire drawing machinery generally for upto 1 mm in ferrous metals and upto 0.5 mm in non-ferrous metal. The machines for the finer wire drawing are produced by the units in the organised sector only.

0.12.6 A demand assessment of the machines indicate a requirement of 160 wire drawing plants in 1994-95. This demand is expected to grow at an average growth rate of 7.94% till the year 2000.

In view of the past performance in exports of wire drawing plants, the same is expected to grow atleast 15% every year till 2000 from the level of about Rs.225 lacs in the year1993- 94.

0.12.7 The quality of the wire drawing machines available in the country for ferrous wires is of a reasonable level. The quality of winding wire machines for copper and aluminium is also of reasonable level. The Indian Electronic and Electrical Manufacturers Association (IEEMA) has indicated that the wire drawing and enamelling plants available in the country are not matching the internationally available plants on account of following reasons.

- Processing Speeds are lower by two to five times
- Power consumption is higher by about 100%
- Scrap produced is about 3% more
- Packings are small which lead to limitation in production.

0.12.8 IEEMA has submitted a report to the government indicating that upgradation of technology in wire drawing machines and enamelling plants be encouraged so that :

- The speed of the wire drawing plants may become 3 to 4 times higher than the present speeds of the wire drawing plants.

- Packing of drawn wire be standardised to larger sizes say 15 to 20 times larger to the present packing sizes.

0.12.9 India is now in a position to supply indigenously manufactured complete wire drawing plants. However, for further growth of exports latest technologies to manufacture multi wire drawing machines, fine wire drawing machines be inducted to make such machines available for upgradation of local wire drawing industry as well as for increasing export.

0.13 RECOMMENDATIONS

0.13.1 In the range of bull block machines the manufacturers may provide multi speed machines. Single speed machines are suitable only for steel wire drawing industry.

0.13.2 Rod breakdown machines with higher speed upto 40 meters /second may be developed. At present manufacturers offer speed upto 20 mts/ second. This will increase the productivity and can be helpful in enhancement of exports.

0.13.3 The intermediate wire drawing machines with better out put i.e. with process speed upto 70 meters per second may be manufactured as available from manufacturers abroad.

0.13.4 Take up reels of wire drawing machines generally influence productivity. A larger take up weight not only can improve productivity of drawing machines but can also improve productivity in subsequent operations. Thus take up reels may be standardised and its weight requires to be increased.

0.13.5 The speed of fine wire drawing machines is also low in Indian machines available indigenously and this need to be increased. Also the output diameter available with Indian machines is higher. Joint efforts of manufacturers and R&D institutions in this area can yield better results.

0.13.6 The machinery manufacturers may replace hardened alloy steel capstans with ceramic, tungsten carbide or flame coated capstan rings, because hardened alloy steel capstans wear faster.

0.13.7 Most of the wire drawing machines manufacturer feel that complete plant and equipment along with the processing lines should be offered, so that the entrepreneur may not face problems such as matching capacity of different equipments, maintenance requirements of different machines from different sources and above all the quality of end product, which will be uniform if the supplier offers complete wire drawing and processing line on turnkey basis. The plant suppliers can explore this possibility and consider to expand their manufacturing capabilities and try to offer the equipments on turnkey basis.

0.13.8 The quality of machines manufactured by small scale manufacturers needs improvement.