EXECUTIVE SUMMARY

0.1 Welding and cutting processes which are most extensively used are : Manual Metal Arc, Tungston Inert Gas, MIG/MAG, Submerged Arc, Spot Welding and Oxyacetylene Welding and Cutting. Resistance Seam, Projection & Flash Butt Welding and Plasma Arc Welding & Cutting are comparatively less used. The processes which are sparingly used are - flux cored, electroslag, electrogas, electron beam and laser beam welding. In the arc welding category, the pattern of usage broadly is :

- MMAW - Transformer Welding Sets	70%
- MMAW - Rectifier Welding Sets	18%
- MIG/MAG	8%
- TIG & SAW	4%
	100%

0.2 There are 12 major active units manufacturing welding equipment in the organised sector, having individual annual production ranging about Rs. 30 lakhs to Rs. 15 crores. Similarly, there are about 40 active small scale units whose individual production ranges from Rs. 2 lakhs to Rs. 25 lakhs. Production Pattern between organised and small scale sector in the country and their production level in money terms is:

Sector	Production Value 1992-93 Rs. Crores	Per cent Pattern
Organised (12 Major Active Units)	52	70
Small Scale & Cottage/ Tiny	22	30
	74	100

Local consumption in 1992-93 of welding equipment is the order of

Rs 73 crores and the likely indigenous demand by the end of VIIIth Five Year Plan (1996-97) may reach a level of Rs. 107 crores/year.

0.3 There is an import of specialised category of welding equipment and the import level is Rs. 2 crores to 2.5 crores/year. The components and raw materials required for indigenous manufacture of welding equipment have more customs duty than for complete equipment.

There is very marginal export from a few welding equipment manufacturers.

0.4 There are various problems faced by welding equipment manufacturers and the major ones are :

- Scattered Market
- Lack of quality consciousness amongst user Industry - particularly General Engineering and Fabrication Industry
- Low volume of demand for higher generation equipment
- Quality of input raw materials is not upto the mark
- Disproportionately high price of raw materials and components vis-a-vis international prices
- Advanced technology welding equipment is expensive to manufacture because most of the power electronics components need to be imported.

0.5 Some of the larger and old companies manufacturing welding equipment do have a sound manufacturing base in respect of production facilities, drawing and design capability, systematic layouts and good work culture conducive to quality production (Advani, Esab, Jai Hind Sciaky etc.). In these companies manufacturing technology/ methods involving plant and equipment are at par with other good and progressive engineering units in the country.

As regards Product (Welding Equipment) Technology, it was based on foreign collaborations from time to time from Switzerland, Germany, U.S.A., Sweden, U.K. and Japan. These units had the credit of fully absorbing the technology then imported and they have not faced any serious problems to get along with the collaborators.

0.6 Another set of welding equipment manufacturing companies, which started as small units but presently have grown into medium sized units, though have overall manufacturing capability, are lacking in upto-date, systematic and spacious production facilities. Product Technology is based on in-house expertize. As regards manufacturing technology/ methods, they are depending on sub-contracting, bought-outs and more labour-oriented manufacturing techniques.

0.7 Thyristor, transistor and inverter type power sources are the things of the past in industrialised countries. Further development is the *Synergic MIG/MAG welding* sets with pulse frequency in which electrode feed speed is linked with one or more pulse parameters.

In case of sub-merged arc welding the advancement available is the use of tandem wire heads and/or addition of metal powder to increase the yield. In Japan, more than 40% of welding is done by this method in world's largest shipyard. In India, the extent of SAW is just 2% of the total electric arc welding.

In case of TIG welding, use of hot filler wire and mechanised/automatic movement of the TIG torch and the wire feeding are the common sights in U.S.A., U.K. and Japan. A beginning in a very small way has been made in India to produce ''Tooled-up'' TIG special purpose machines for automobile and electrical equipment industry.

0.8 Advanced welding processes like Electron Beam Welding and LASER welding are being used in the industrialised countries for production purposes also. Electron Beam Welding Equipment of 3 to 25 KW capacity and laser welding equipment upto 5 KW capacity are being used. In India, these equipment are not manufactured and the use of processes are witnessing very slow growth because of very exorbitant cost. These processes, however, are being mostly used for R&D purposes. There has been increasing influence of electronics in the technologically advanced welding equipment. Robotics in welding processes, microprocessor controlled welding power sources, use of sensor technology are the examples of this advancement prevailing in industrialised countries. India is devoid of such technological advancements in welding field.

0.9 In the resistance welding field, the machinery currently used varies from old type to modern - even for the same type of product e.g. one automobile manufacturer uses robot and special purpose welding equipment while another uses pneumatic timer controlled equipment. Updating of resistance welding technology had been a slow process, arising, if at all, due to change of collaborator's practice. It was because of lack of exposure of manufacturers as well as users to the state-of-the-art technology in industrialised countries. This scene has started changing after Japanese entered into the Indian automobile industry.

0.10 As regards the indigenous manufacture of complete welding equipment, technology gap exists in the following items :

- Electron Beam Welding Equipment
- Laser Welding Equipment
- Electroslag Welding Equipment
- Friction Welding Equipment
- Stud Welding Equipment
- Welding Joint Sensing & Scanning Systems
- Water Jet Cutting Equipment
- Ultrasonic Welding Equipment; and
- Inverter Type Welding Power Sources

0.11 R&D activities started taking proper visible shape only after 1970s with the establishment of Welding Research Institute (WRI), Welding Research Laboratory (WRL) and also by some large user industries. These R&D activities are more concentrated on welding joint design, fabrication methodology, materials, testing etc. as compared to design & development of higher welding equipment.

0.12 Based on the Study the following **recommendations** are suggested :

0.12.1 Attention need to be focused on improving the design, manufacturing methods and use of quality input materials to produce comparatively efficient machines even in conventional type of welding equipment. Introduction of ISI certification may be considered over the products of tiny and cottage sectors.

Some manufacturers in organised sector also are not very careful about producing quality products, resulting in more down-time at the users end. It is emphasised that both organised sector as well as small scale sector provide quality products to the customers. A sizeable chunk of welding sets (transformer type) are produced in the tiny & cottage sectors who are using low grade laminations and poor quality insulation material, resulting in loss of electrical energy.

0.12.2 Conventional equipment manufacturers may go in for:

(i) edge winding of tranformer coils instead of one layer above the other;
(ii) use of electronic choke system instead of stepped tappings;
(iii) provision of ON/OFF switches on welding transformers.

The reason is in layer above the layer winding heat generated in inner windings remain locked up and more quantity of insulation material is required. Electronic choke system reduces weight and heat loss. For want of ON/OFF switches, the welding set causes no load loss of electrical energy.

0.12.3 Use of aluminium conductor instead of copper windings should be preferred and no user industry may specify copper as winding material in their tender specifications.

0.12.4 Over a period, tiny and small scale sectors may abandon the conventional transformer welding sets of antiquated designs and produce thyristor controlled or fully thyristorised power sources. Concerned bodies/ organissations may make thyristorised designs available to these units at a concessional charges with the assistance of R&D units like WRI & WRL etc. This is a one step technological upgradation and by doing so national energy saving can be effected.

0.12.5 The usage of semi-automatic welding process (MIG/MAG) in the country, though slowly increasing, is just 8% of the total arc welding processes as compared to 50% in the industrialised countries. This usage of MIG/ MAG needs to be increased as the country would gain by way of output

and less energy consumption for the same amount of weld deposits obtained by MMAW. For this, welding equipment manufacturing industry may come forward by offering semi-automatic (MIG/MAG) machines at affordable prices. Today in the country the price ratio between MMAW equipment and MIG/MAG equipment is 1:5 whereas this is 1:2 in industrially advanced countries.

0.12.6 An automatic process like submerged arc welding has not picked up and spread as it should have been. The usage is hardly 2 to 3%. Jobs like pipe welding, pipe to flange welding, railway wagon components, crane manufacturing industries etc. can go in for SAW, but have not shown much enthusiasm in this regard. Their difficulty is the non-availability of special purpose welding fixtures/systems at affordable price. Such welding fixtures/systems are available off the shelf abroad while in India a lot of time is lost in determining the need. Often having identified the need, by the time fixture/system can be delivered, the need has already reduced.

The welding equipment manufacturing industry may have a proper tie-up and can keep common usage fixtures/systems used in Submerged Arc Welding process in CKD condition - backed up by modular designs so that at a very short notice these can be assembled and provided to the users.

In this regard, the bottleneck of non-availability of small size permanent magnet DC motors for cross slides and wire feeders and also liner bearings need to be removed and these are developed indigenously.

0.12.7 Process equipment manufacturing industry in the field of chemical plants, refineries, food and dairy plants, atomic plants are using manual TIG welding spending considerable productive time and more rework. ''Tooled up'' TIG welding systems is the demand of user industry.

There is therefore a need to strengthen the effort on the part of welding equipment manufacturers to provide fixtures and systems so as to make TIG process mechanised/automated. There could be automatic feeding of filler metal, mechanised movement of TIG torch or the component to be welded.

0.12.8 There is a need that Indian industry should switch on to manufacture and use of static power source with solid state devices (thyristors) at the earliest. This may be based on inverter technology. By this way tremendous amount of electrical energy may be saved per year.

0.12.9 For encouraging quicker adoption of technology and wider use in industry, electronic devices and components manufacturing companies (like BEL, ECIL, MELTRON, CEL etc.) should come forward to develop high end technology and create facilities to manufacture the same. These items are :

- High power electronic devices like Darlington power transistors, fast recovery diodes, soft recovery diodes, MOSFET etc.

- Ferrite cubes and cores for inverter type welding power sources
- Tactile and inductive type sensors for making seam tracters

0.12.10 R&D establishments can take up developmental work of welding equipment on their research programmes and allocate suitable technical skills comprising of a team of engineers from electrical, power electronics, mechanical and welding disciplines.

There is a need for establishing a centre for research and development at national level in the field of Welding Equipment or enhancing the facilities of an existing centre. Welding Research Institute Trichy could be one possibility.

As regards automatic/mechanised welding systems, collaboration arrangement between welding equipment manufacturer and machine tool manufacturer need to be established so as to derive benefits of later's experience and capability.

0.12.11 For rapid development of MIG/MAG process in synergic mode (quite popular abroad) there is urgent need for gas mixing units in the country.

At present only one or two gas manufacturing units have these gas mixing unit for their own use. Users of MIG process have to essentially depend upon these two units for gases, which is very difficult. Unless

the users can prepare their own gas mixtures, this process may not develop to the desired levels.

0.12.12 Gas regulators and flow meters for dry gases are being manufactured in the country, but not for MIG/MAG welding, which requires CO_2 gas. It has moisture most of the times. Indian manufacturers may manufacture good quality regulators and flow meters for use in MIG/MAG process where CO_2 gas is not essentially dry.

0.12.13 A task force needs to be formed which could have members from welding equipment manufacturers, research institutes and concerned government departments. This task force may identify the problems of welding equipment industry and seek feasible solutions.