I. Historical Survey

The earliest alignment charts, with few actual tests, were published between 1900 and 1007 by British and American machine tool makers, and were used only to show the results of the inspection of the machine tool in the manufacturer's works before delivery.

In 1901, Dr, G, Schlesinger, then Chief Engineer of the Ludw. Loewe Company of Berlin, was asked to arrangesrrfrii: acceptance charts for the use of that firm in their own works, and for their own products, but as no recog- nised system of fits and tolerances existed at that time there was no relation between the accuracy of the work produced and the machine producing it.

By 1903, a set of 40 test charts had been developed, to cover a variety of machine took, and were put into daily usage by Ludw. Loewe. The numerical values of the charts were elaborated by the Research Department of the Charlottenburg University from 1904 onwards. The first publication of a test chart showing tests and alignments as a manufacturing basis for machine tools, was made in Germany in September, 1909, using a universal milling machine as an example.

During the period 1909 to 1931, Dr. Schlesinger was Chairman of the Standards Committee of the German Machine Tool Makers' Association In 1909 he proposed that the Association should adopt his charts for tests and alignments, but the the proposal was rejected on the grounds that unifor• mity and classification of detailed tests were impossible. Shortly after this, the Russian Government placed large orders for machine tools in Germany, stipulating acceptance of the machines in Russia, but did not define their tests. To obtain data, the Russian; collected information from German firms, and selected, from the figures supplied to them, the closest specifica• tion of tolerances that they could find in the various types of machine tools. As a result, specifications were produced with tolerances which, in many cases, were unnecessarily fine, unsuitable and too costly.

These arbitrary charts led to the rejection of a large number of German machine tools, and to settle the controversy which developed, the parties nominated Dr. Schlesinger as arbitrator, on the understanding that he would be free to prescribe the final acceptance tests.

In September, 1927, the first edition of the Schlesinger book des• cribing this work was published and adopted by the Russian Government and the German machine tool industry. As a result, some of the German makers had to change their manufacturing organisation in order to produce quality work, but did this with such success that the reputation of their machines rose greatly in the international market.

In the French translation of the book (1929), a clear line was drawn between the accuracy of the machine and the accuracy of the piece finished on the machine, and the distinction between the two types of tests was made by classifying them as " Geometric " and " Practical " tests respectively.

In 1933, Lt. Col. P. Salmon (Head Inspector of the French Government and purchaser of machine tools for the whole of their national services) expressed the view that it was necessary to stipulate the conditions under which the practical tests should take place, and that only in exceptional cases was it necessary to insist on tests and alignments for the machine tool. He further advocated that the measurement (or geometric tests) of machines should only be carried out at the express wish of the purchaser. He thus emphasised that working tests were essential, and that subsequent static tests might be optional. At the present time, amplified proposals by Lt. Col. Salmon have been placed before the I.S.A. Committee 39.

The conflicting claims of the Schlesinger " geometric" and the Salmon " practical " systems for use as an international standard have been discussed by the I.S.A. Committee over a long period and have pre• vented agreement. The controversy began in 1936 at Budapest and Berlin, and was continued in 1937 in Paris, in 1938 at Stockholm, and in 1939 in Rome and Helsinki*.

The I.S.A. meetings generally comprised representatives of six nations : Germany, France, Italy, Belgium, Sweden, and Switzerland. Great Britain and America, up to the present, have taken no part in this work officially, and the British Machine Tool Trades Association, although interested in what was happening in France and Germany, did not take corporate steps to put forward any standards for machine tool alignments.

In 1937, Mr. H. C. Armitage of The Austin Motor Co. Ltd., tested out 300 new machine tools (mostly British) against Schlesinger standards, and the experience then gained showed :

(1) That there was an enormous advantage to the machine tool user in testing out the machines, both geometrically and practically, when they were actually fixed in the users' works.

(2) That first-grade machines were being generally constructed to closer tolerances than those advocated.

(3) That Schlesinger charts in their present form were not entirely suitable for the requirements of tests *in situ.*

* Dr. Schlesinger claimed that practical or working tests were an inseparable part of the acceptance of the machine, in order to prove that the mounting of the machine was correct. This is of importance, for it should be noted that acceptance tests do not mike provision for measurement of the parts of a machine tool, but for measurement of the accuracy of the assembled machine. This means that all the tolerances admissible in the manufacture of the individual parts have been utilised in order to introduce the necessary accuracy into the sub-assemblies and final erection.

It is essential that the machine tool maker who applies a standardised fit system (e.g. the B.S.I, system, Grade B-U-V-W, superfine fits, etc.), to the production of his separ• ate parts, should assemble these parts into the machine in such a way that variations within the permitted tolerances are equalised. The work produced by the machine will then be within the general permissible accuracy of the complete machine.