

**A Review of
Investment
Casting Market
Trend Data**

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A REVIEW OF INVESTMENT CASTING MARKET TREND DATA

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INTRODUCTION

The opening session of our Conference presents a global review of investment casting markets and this, a popular feature of European conferences, is one of a series of such reviews held during the past decade.

Four such reviews, from conferences in 1994 [1], 1996[2], 1997[3] and 2000[4], were subsequently published and these provide a wealth of information about the state of investment casting markets.

Using these publications and two published papers, this paper seeks to examine how investment casting markets have developed over the past two decades and to determine whether this published information gives any relevant pointers to today's situation.

METHODOLOGY

The first major, indeed the seminal, publication on the subject of investment casting markets, was a paper by Gould and Baker [5] of the then English China Clay Co., presented by Gould at the 6th World Investment Casting Conference in 1984. Although much of the data had, inevitably, to be estimates or even 'informed guesses', this paper set the approach to the subject for virtually all subsequent studies.

At the EICF Conference in Paris in 1992, one of the present authors (Williams [6]) gave a paper on world investment casting markets with information for the years from 1988.

The papers by Gould and Baker estimated output in terms of annual turnover for the three main producer areas (US, UK and (Mainland) Europe and Japan.) Williams did the same but included a World total by giving an estimate for 'others' ie countries for which no data could be obtained.

From 1994 onwards, the three major regions were re-designated as North America, Europe and the Far East (or Asia) and efforts were made to include data from more countries. While these efforts made the surveys much more comprehensive and more useful, there remained one major gap in the coverage. There was no quantitative information about the Chinese investment casting industry, which anecdotally was believed to be growing rapidly; it was only at the World Conference in 2000 that reliable information from China was obtained.

The change in designation of the major producer areas to North America, Europe and the Far East was logical and beneficial but it caused problems with integrating the 1982 - 1991 data with the statistics from 1993 onwards. To allow comparison, the

earlier results based on the US, UK, Europe and Japan have been amended and are shown as North America, Europe and the Far East.

When quantitative information was used from published sources, the data were ascribed to the year to which they referred and not to the date of publication. Gould and Baker used 1982 data in their paper and this has been used as the base year in the present paper. In all cases, turnover figures have been converted to US dollars.

COMPARATIVE ASSESSMENT OF AVAILABLE DATA

The comparisons carried out in this exercise have concentrated on the following:

- * Total reported global turnover for the investment casting industry
- * Turnover by country/region
- * Distribution of investment castings by end markets
- * Percentage use of different alloys
- * Effect of inflation on US and UK turnover figures

Size of Investment Casting Market

Table 1 and Figure 1 show the turnover levels between 1982 and 2001 both globally and by geographical region.

Gould and Baker gave an estimated turnover for the US, Western Europe and Japan in 1982 of US\$1865m (million). No estimate was given for production in other countries, but an addition of 10% has been made in the present study to give a global figure.

From Williams's paper, it is clear that World output grew substantially during the 80s reaching US\$3610m by 1988 and climbing to a peak of just over US\$4390m by 1990; a decline was then recorded in all three geographical regions and the 1990 total was not exceeded for the next 4 or 5 years.

In 1996 at the Maastricht Conference, the total turnover (for 1995) was reported as US\$4250m and this rose to an estimated US\$5000m in 1996 at the BICTA Conference in 1997.

At the 2000 World Conference, it was possible to obtain perhaps the most accurate estimate of investment casting total turnover since there were contributors from 10 of the principal geographical areas speaking about output and usage in their own area of expertise. In addition, for the first time it was possible to include statistical data for Chinese output, based upon information provided by the China Foundry Association.

The total World turnover of investment castings for 1999 was estimated at the beginning of the review as some US\$5100m. However, detailed examination of the individual speakers' presentations (and including the reported Chinese turnover) led to

the conclusion that the global turnover for investment castings for the year 1999 was substantially higher than originally estimated and stood at about US\$5860m.

Further data have been obtained from annual surveys of the industry published by INCAST magazine in January 2001[7] and January 2002[8]; these suggest that the global investment casting market was about US\$6070m in the year 2000 and US\$6900m in 2001.

Thus, over two decades, the annual turnover of the investment casting industry has grown from US\$2075m to US\$6900m, an increase of over 200% or some 10% per annum.

Production by Country/Region

The percentage share of the global market by geographical region is listed in Table 2. The data show clearly that the US has, over the period considered, been the principal, and dominant, producer of investment castings; its percentage share of the market was around 70% in 1982, falling in the late 80s and early 90s as other parts of the World developed their production; however, over the past few years the US has increased its share of the global market to its current level of 58% in 2000.

The European market turnover (Table 3), which was reported as 26% of World output in 1990 figures, fell back during the decade and stood at only 22% by 2001. Within this scenario the UK was the largest producer of investment castings with France and Germany in second and third place respectively; indeed, it may be noted that the UK share of the European market has risen significantly in recent years and is nearly 45% of the total output.

The Far Eastern percentage has changed considerably over the years. The early returns indicate the rise of the Japanese investment industry, together with gains in other Far East countries. Japan's industry flourished until 1996/7 (accounting for 60% of Far East output) after which a decline set in. until a recent improvement.

However, as already indicated, these Far Eastern percentages did not include Chinese output. The earliest turnover figures known for China were for the year 1988, when output was placed at US\$400,000 compared with a turnover of US\$549m reported for 2001. Retrospectively, the output of Japan and China has been compared over the past eight years and the results are shown in Figure 2; this highlights the dramatic increase in Chinese production over the period.

Chinese industry divides investment casting output into two classes, the first being high technology processing and the second lower technology. The former accounts for about 70% of total output and it provides most of the exports of investment castings, which currently are said to run at US\$350m (having doubled in value since 1998.)

Effects of Inflation

The strong growth of investment casting turnover over the past two decades has been impressive, but it has been achieved during periods of varying inflation, and it is interesting to consider how much of the growth has been due to 'real' growth of the market and how much due to inflation.

Calculations of the effects of inflation on investment casting turnover (or anything else) are difficult but, based upon published figures, it seems that both the US and UK investment industries have managed over the past two decades just to keep ahead of inflation, which surely represents a generally satisfactory situation.

End Market Distribution

Historically, investment casters tended to divide castings into two groups: documented (or released) castings and general commercial castings. Data obtained from the US, UK and Japan for the years 1982 to 1999 (Table 4) suggest that the ratio of documented/commercial castings in the US remained virtually constant at 60/40 until an increase was noted in 1995.

In the UK, the ratio was also around 60:40 but with variations on both sides; the ratio in the rest of Western Europe tended to be lower at round 40:60. In Japan, the figures indicate a slightly rising ratio of documented/commercial castings from 10% in 1982 to around 15-20% by 1997; however, the 1999 data show a marked increase in the ratio to 43:57, indicating the Japanese industry is moving more heavily into aerospace/gas turbine castings.

The documented commercial division is, at best, a rather imprecise measure and interest has turned more to categorising by end use categories; recently there has been agreement to quote output in terms of certain specific categories. There are not sufficient early results to allow comparison but the 1999 data are shown in Table 5.

Alloy Usage

Reliable data on the percentages of alloys used in investment casting are, surprisingly, difficult to find. Williams quoted a figure for Worldwide usage in 1991 (in terms of value) of:

| | |
|-----------------------------|-----|
| Steels (all types) | 35% |
| Superalloys (Ni & Co-based) | 50% |
| Other non-ferrous alloys | 15% |

These are obviously averaged figures and there must be wide variations between countries (according to the nature of their customer base).

In the UK, for example, the 1996 and 1999 splits were considered to be:

| | 1996 | 1999 |
|-------------------|------|------|
| Steels | 36% | 25% |
| Superalloys | 52% | 63% |
| Other non-ferrous | 12% | 12% |

In the US, on the other hand, the 1999 figures place steel usage at 44.2%, superalloys at 37.4% and other non-ferrous alloys at 18.4%. In that latter figure, more than half (10.3%) is attributed to titanium castings and only 8.1% to the traditional aluminium and copper castings.

Table 6 gives some 1999 information on alloy usage in various countries. [9]

CONCLUSIONS

The information used in the comparisons in this paper have been, of necessity, less than exact, particularly when dealing with the early publications; in addition, in some cases estimates have had to be made to allow meaningful comparisons to be made. Overall, however, it is felt that the available data are sufficient to allow valid conclusions to be reached.

In recent years, there has been growing interest in obtaining reliable statistical data and more care has been taken across the industry to obtain such information. The holding of regular market survey sessions at conferences has clearly increased interest in the subject; it is due to the many people who have contributed in this field that we now have fairly reliable statistics that cover virtually all the significant producer areas for investment casting.

The global annual turnover figures for the past twenty years indicate an industry that is buoyant and growing; apart from a decline in output in the early 90s, the World turnover figures have been consistently upwards year-on-year. There have certainly been downturns in specific countries or areas during the past six or seven years but the global trend has been consistently upward and it is clear that buoyancy in some areas has more than compensated for those that were stagnating. Certainly in the US the upsurge in aerospace and IGT orders has fuelled an increase in total; equally obviously other sectors, especially of the commercial market, have suffered.

World sales of investment castings are now around 3 times the level they were at in 1982, an average global increase of over 16% per annum total. Some areas have done better than this, others less well; the US increase has been under 10%, Europe around 15% and the Far East over 40%: these different percentages reflect the differences in the growth and nature of the markets in these areas.

It may be noted that over the past 15 years, investment casting turnover in China apparently increased by more than 400%. What is also particularly significant is the scale of their exports of castings - doubling in three years from 1998 to its present



level of around US\$350m per annum. These are facts that the established industry would do well to consider and react to.

The dominance of US production has been evident throughout the history of the modern investment casting industry and it persists to the present time. With a share of the market of 60% and upwards, the US will inevitably continue to dominate the future development of global investment casting. In Europe, the UK industry, in terms of turnover output, is by far the largest European producer and will also tend to lead European investment casting. In the Far East, China has already become the principal producer and this dominance is likely to continue in the future.

Overall, the data indicate a buoyant and growing investment casting industry, with wide diversity in conditions and markets from area to area. The industry relies very much on traditional markets for its prosperity. While turnover continues to grow, there is little evidence of the industry making any 'quantum leaps' into radically new markets that technical papers (for half a century) have suggested were well suited for investment castings.

The automotive market illustrates the problem; despite the apparent opportunities for investment castings, sales of investment casting for the year 2001 in the US, UK and Japan averaged less than 5% of total turnover. This is one market that seems to lag behind in exploitation from the level suggested by technical literature for investment castings; perhaps the capital investment to exploit the casting process is just too large in very many cases.

The investment casting industry, although growing, seems to lack concerted promotional activity. Most advertising campaigns to date have been locally based and seem to have had limited effect; what may now be needed is an international promotional campaign, organised and co-ordinated by investment casting associations around the World, to increase awareness of the potential of the technique.

In summary, this study has shown the investment casting industry to be in 'good shape', buoyant despite difficult trading conditions. The potential looks good but is reliant, to a great extent, on continuing demand from the aerospace and IGT sectors. The established production areas need to take account of the Chinese investment casting market in drawing up their future strategy. Finally, an internationally organised advertising campaign for the industry as a whole would seem needed if the markets are to grow in non-traditional fields.

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TABLE 1
REPORTED ANNUAL TURNOVER FOR INVESTMENT CASTING INDUSTRY
1982 - 2001

| YEAR OF DATA | ANNUAL TURNOVER, millions of US dollars | | | | | DATA REFER- ENCE |
|--------------------|---|--------|----------|--------|-------|------------------------|
| | N. America | Europe | Far East | Others | Total | |
| 1982 | 1470 | 375 | 120 | 110 | 2075 | 5 |
| 1988 | 2130 | 850 | 450 | 180 | 3610 | 6 |
| 1989 | 2300 | 1030 | 470 | 200 | 4010 | 6 |
| 1990 | 2500 | 1150 | 520 | 220 | 4390 | 6 |
| 1991 | 2300 | 1000 | 550 | 200 | 4050 | 6 |
| 1993 | 1910 | 970 | 700 | 200 | 3780 | 1 |
| 1995 | 2125 | 1075 | 850 | 200 | 4250 | 2 |
| 1996 | 2600 | 1250 | 850 | 300 | 5000 | 3 |
| 1999 | 3240 | 1350 | 1150 | 120 | 5860 | 4 |
| 2000 | 3350 | 1450 | 1150 | 120 | 6070 | 7 |
| 2001 | 4000 | 1500 | 1250 | 150 | 6900 | 8 |

TABLE 2

**PERCENTAGE SHARE OF INVESTMENT CASTING MARKET
BY GEOGRAPHICAL AREA**

| YEAR | US | EUROPE | JAPAN |
|------|----|--------|-------|
| 1982 | 71 | 18 | 6 |
| 1988 | 59 | 23 | 12 |
| 1990 | 57 | 26 | 12 |
| 1993 | 51 | 25 | 18 |
| 1996 | 52 | 26 | 17 |
| 1999 | 52 | 23 | 17 |
| 2000 | 55 | 24 | 19 |
| 2001 | 58 | 22 | 18 |

TABLE 3

**PERCENTAGE SHARE OF EUROPEAN INVESTMENT CASTING
TURNOVER - BY COUNTRY**

| YEAR | UK | FRANCE | GERMANY |
|------|----|--------|---------|
| 1993 | 39 | 22 | 16 |
| 1995 | 42 | 26 | 19 |
| 1997 | 44 | 26 | 17 |
| 1999 | 44 | 26 | 17 |

TABLE 4

**RATIO OF ANNUAL TURNOVER VALUE OF
RELEASED (OR DOCUMENTED) CASTINGS TO COMMERCIAL CASTINGS**

| YEAR OF DATA | U.S. | U.K. | JAPAN |
|-----------------|-------|-------|-------|
| 1982 | 60/40 | 70/30 | 10/90 |
| 1988 | 60/40 | 65/35 | 20/80 |
| 1991 | 60/40 | 62/38 | 20/80 |
| 1995 | 65/35 | 60/40 | 17/83 |
| 1999 | 70/30 | 66/34 | 43/57 |

* 1999 ratios calculated from sum of aerospace and IGT components to yield an estimated figure for released castings.

TABLE 5

END USER CATEGORIES FOR INVESTMENT CASTINGS: 1999 DATA

| CATEGORY | U.S. | U.K. | JAPAN |
|--------------------|------|------|-------|
| Aerospace | 46% | {67% | 15% |
| IGT | 25% | { | 29% |
| Automotive | 3% | 7% | 18% |
| Sporting Goods | 7% | 1% | 3% |
| General Industrial | 18% | 26% | 35% |

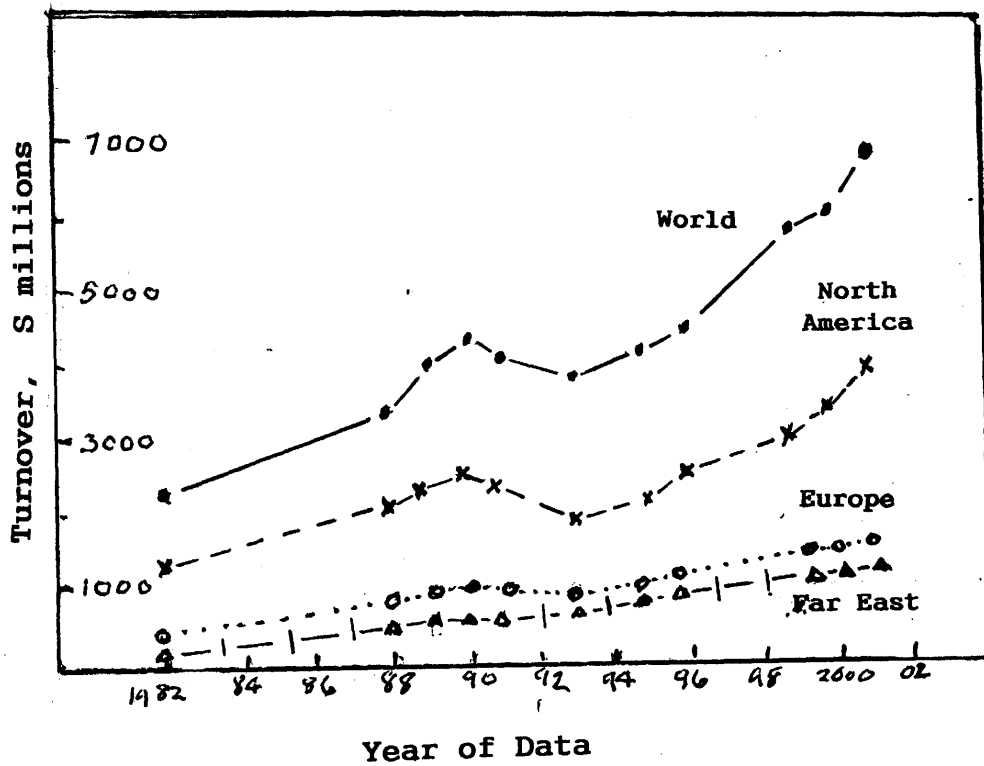
TABLE 6

**PERCENTAGE ALLOY USAGE IN INVESTMENT CASTINGS
FROM VARIOUS PRODUCER COUNTRIES - 1999/2000 DATA**

Figures from different sources

| ALLOY TYPE | U.S. | U.K. | FRANCE | GERMANY | JAPAN | CHINA |
|---------------------|------|------|--------|---------|-------|-------|
| Steels (+cast iron) | 34 | 25 | 38 | 75 | { 73 | 91 |
| Super alloys | 51 | 63 | 50 | 13 | { | { 9 |
| Other Non-Ferrous | 15 | 12 | 12 | 12 | 27 | { |

**Fig. 1 INVESTMENT CASTING TURNOVER
1982 - 2001**



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