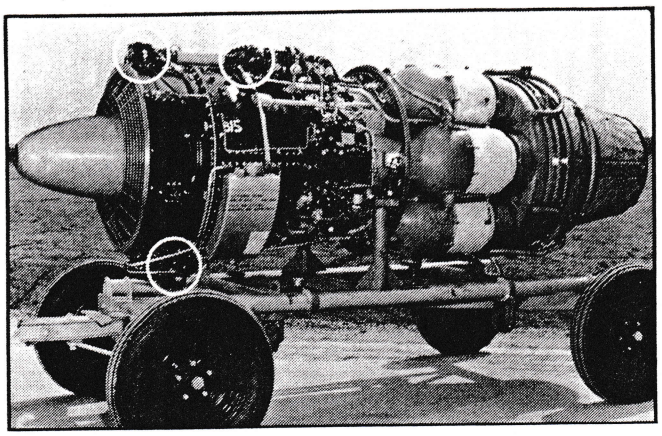
Vacuum Impregnation Cuts Rejections of Mg Castings



Housings of these gearboxes (circled) on the Orenda are magnesium castings which have been impregnated under vacuum to correct micro-porosity and give a product that will stand up under severe service of jet operation.

STEADY deliveries of magnesium gearbox castings guaranteed to stand up in service under the exacting requirements of jet engine operation, are now being made to the Gas Turbine Division of A. V. Roe Canada Limited by York Gears Limited, Toronto. Impregnation of the castings with Permafil 3255 in vacuum equipment designed and built by F. J. Stokes Machine Company, Philadelphia, Pennsylvania, has resulted in a minimum of rejections of the castings. This in turn has meant a considerable saving in time and labor, and a higher and steadier flow of production.

York Gears Limited, formerly York Division of Canadian Acme Screw & Gear Limited, is the only factory in Canada wholly devoted to making aircraft engine gears. As such, the company is a key subcontractor to Avro Canada, whose Orenda powers both the CF-100 and the Sabre 5.

The high rotation speeds of the Orenda's compressor/turbine assembly —which may run over 11,000 rpm— call for a gearbox housing that is sturdy enough to stand up under considerable stress. Yet the part must also be light in weight. Magnesium is the natural choice for such castings, because of its lightness and strength. But magnesium castings are prone to develop micro-porosity during manufacture, due to shrinkage as the molten metal solidifies.

Oil Leak: Porous gearbox housings would leak oil under operating conditions and hence would be unsatisfactory in service. Moreover, under the severe pressure and load conditions of high-speed, high-altitude operations, the porosity in the casting might develop into serious cracks or fissures which could possibly cause failure of the housing.

For these reasons, only castings free of porosity can be accepted for jet-engine service.

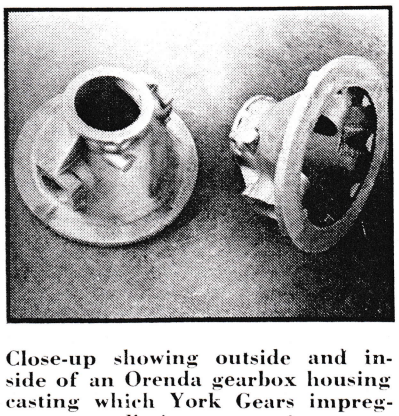
If only perfect castings could be accepted, rejects would run extremely high, and costs would be likely to become exorbitant. Fortunately, vacuum impregnating has proved its merit as a means of correcting porosity in aluminum and magnesium castings and obtaining sound, dependable components. Its economy, in reducing rejects and in saving time and labor already expended on parts that do not now have to be scrapped, is obvious.

Canadian Acme Screw & Gear Ltd. knew this when its York Division first undertook to make its own gearbox housing castings two years ago. The company, formed in 1924, had grown during World War II from 200 employees to more than 3,000, and had also managed the York Arsenal, with another 3,000 employees.

Long Experience: Canadian Acme's long experience in the manufacture of automobile and truck transmissions, rear axles, differentials and hydraulic shock absorbers, and aircraft gears and gearboxes had shown the limitations of untreated castings under severe operating stresses such as those encountered in aircraft engines. So, when the York Division began to make its own castings in July, 1951, Chief Metallurgist J. R. Mott and Operating Metallurgist A. P. Munro ordered Stokes vacuum impregnating equipment installed for treating all their gearbox housings and other castings.

The impregnant used for correcting porosity in these magnesium jet engine gearbox castings is Permafil 3255, a synthetic thermosetting resin developed by the General Electric Company's Plastics Department and supplied in Canada by Canadian General Electric Company Ltd.

Magnesium gearbox housing for Orenda is placed carefully in Stokes vacuum impregnating chamber by operator at York Gears. Large castings like these are loaded individually; smaller castings in perforated metal baskets.



Close-up showing outside and inside of an Orenda gearbox housing casting which York Gears impregnates to eliminate porosity.

Castings come to the impregnating process directly from the foundry after the removal of flash metal. Unless they are oily or greasy they do not need

The Facts about Weatherfax

Late last summer the DoT's Meteorological Service officially inaugurated the Canadian Weatherfax System, a new facsimile system for the transmission of weather maps by telegraph and wireless, and the first fully automatic service of its kind in the world.

The inaugural ceremony was held at Dorval in the Meteorological Service's Central Analysis Office, where the act of sending out the first map to go over the system officially was carried out by Minister of Transport Lionel Chevrier and Chief of the Air Staff C. Roy Slemon.

In a brief talk before sending out the map, Mr. Chevrier gave credit for the development of the service to Canadian Pacific Telegraphs, Canadian National Telegraphs, the Muirhead Company of England (who make the facsimile equipment) and the RCAF, all of which worked closely with the DoT.

The first use of facsimile to meet the weather service requirements of Canada took place during the latter part of World War II, when to maintain proper control of RCAF trans-Atlantic operations, the weather maps available only at Dorval were required at Ottawa. Subsequently two transmission machines were obtained and routine transmissions between Dorval and Ottawa commenced. At the War's end, this service was no longer needed and the machines were transferred to meet minor operational requirements on the east coast.

However, this wartime experience coupled with the continued use and development of facsimile equipment in the U.S., led the RCAF and DoT to combine in further operational tests and development of the equipment to meet the exacting requirements in Canada.

The employment of Weatherfax permits weather maps to be drawn centrally by a specially trained team at the Central Analysis Office, which is under the direction of J. M. Leaver. These "master" maps are then transmitted to all National Defence stations across the country. Big advantages are that mistakes are impossible and the transmissions can withstand a higher degree of electrical or radio interference, or atmospherics, without serious loss of data, than any other form of communications.

Thus, at each RCAF station are available complete weather maps covering all levels up to 50,000 feet. Without the Weatherfax System it would be tremendously expensive to provide this same service independently at each Air Force station, and in fact, from a manpower standpoint it would be impossible.

When in full operation, Weatherfax will combine regional and national transmissions. Every six hours the Central Analysis Office will transmit a complete series of weather maps and associated charts and diagrams. This transmission will be so arranged that all stations in Canada will receive the charts simultaneously.

At intermediate times the system will be broken down regionally, so that each of the main district forecast offices will be able to send supplementary material of regional significance to the National Defence stations in their districts.

While at the present time Weatherfax is being established for the military, once the needs of the armed services are fully met, the System is to be expanded in order to make it available to civil aviation.

At the Weatherfax inaugural were, L to R: M. Metcalf, CNR vp & exec. asst.; A/M C. R. Slemon; D. F. Bowie, Canadian Overseas Telecommunications pres.; Transport Minister Chevrier; A. Lyle, CPR asst. vp; G. C. W. Browne, DoT Controller of Telecommunications; Andrew Thomson, DoT Controller of Meteorology.

preliminary cleaning: where necessary, this is done by a 30-second pass through a vapor-type degreaser.

The castings are loaded individually into the Stokes vacuum impregnating chamber. They vary in size, and from 15 to 100 pieces may be treated in a single batch.

The chamber is sealed, and a vacuum is drawn—27 to 29 inches, for as complete an evacuation as is possible—for one hour, to remove virtually all the air from the pores of the casting.

Impregnation: The supply line from the impregnant storage reservoir is then opened and Permafil is drawn into the impregnating tank by the vacuum until it covers the castings completely. The vacuum is maintained for half an hour, then it is broken and air is introduced and a pressure of 100 psi. built up and maintained on the surface of the impregnant for an hour to speed up the impregnation process. The return line to the impregnant reservoir is then opened and the air pressure reduced to 5 psi which is sufficient to drive the excess Permafil out of the impregnating tank and back to the storage reservoir.

Impregnating tank and castings are thus drained of Permafil. The castings are then cleaned in a lukewarm water-solution containing a mild detergent (similar to domestic "Vel") at 120° F., which removes any excess plastic on the surface of the castings. The castings are then rinsed in clear water at the same temperature, and placed in a curing oven where they are baked for one hour at 200° F. to thoroughly set the plastic.

York Gears operates its Stokes vacuum impregnating equipment with a single operator per shift, two shifts a day, five days a week. Total time for impregnating each batch of castings is 5½ to 6 hours.

As they had expected, York Gears' metallurgists find that very few castings must be rejected, when vacuum impregnating with Permafil has been used to correct porosity. This means a considerable saving in labor and time, and a steady production flow of a good-sized volume of components is achieved. Use of the Stokes vacuum impregnation equipment enables York Gears Ltd. to guarantee these castings in service, and make an important contribution to the dependability of Avro Canada's jet engines.