80N22340

POSITIVE DISPLACEMENT TYPE GENERAL-AVIATION ENGINES: SUMMARY AND CONCLUDING REMARKS

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During this session, the internal combustion engine program, its status and accomplishments have been presented. Both the near and longer term technical thrusts were discussed. Significant progress on both fronts has been made.

In the near term conventional engine area the integration of four modifications in a test engine provides for a 10 percent improvement in the high-performance-cruise fuel economy while meeting the emissions standards.

A new program aimed at improved cooling and drag reduction has been established. The Phase I effort on improved-cylinder head-and-barrel cooling will be underway at Teledyne Continental Motors, Aircraft Products Division, by the end of this year.

The grant program to develop and verify a realistic Otto cycle computer model shows significant progress at the two-thirds completion point. Today, calculations of two-dimensional unsteady, turbulent, compressible flow with moving boundaries are being made. The related ambitious experimental program to develop advanced combustion diagnostic techniques has been completed.

In the fuel-injection technology program the contract to Spectron is quantitively characterizing the performance of various injector nozzles. The in-house flow visualization work is studying the same set of nozzles under motored engine conditions by means of high-speed photography.

The effort to define the benefits and requirements of advanced but cost effective turbocharger technology has been initiated. The RFP for Phase I is expected to be issued in early 1980.

For the longer term the results of the on-going studies involving alternative engine configurations were presented. The advanced spark-ignition piston engine study, which is 75 percent complete, shows 0.33 and 0.36 BSFC for the stratified charge and lean burn concepts, respectively. The two-stroke diesel shows 0.36 BSFC and 1.07 lb/hp for the 250-hp cruise version. The stratified-charge rotary engine study, which has been completed to the technology assessment task, continues to be a viable candidate.

The airplane and mission studies by Beech and Cessna will soon be underway. Results from these studies and the on-going Lewis effort will objectively evaluate, rank, and compare the three study engines with each other, with representative current-production engines, and with a highly advanced small

turboprop in terms relevant to the industry. The result of these activities in late FY 80 will be recommendations as to which concepts merit serious technology enablement programs.

The supporting research and technology included both contract and in-house elements. Diesel and rotary engine test cells at Lewis are now operational with baseline mapping complete. Active research programs are underway in such areas as supercharge versus compression ratio tradeoffs for optimum performance; fuel-injection rate, timing, and other parameters; and ceramic combustion-chamber insulation materials. A Curtiss-Wright program confirmed that efficiency improvements in the RC2-75 could be achieved by increasing compression ratio and relocating spark plugs: the BSFC at cruise was improved from 0.54 originally to 0.47.

The University of Michigan, working under a NASA grant, recently completed feasibility tests of a dieselized current-production spark ignition cylinder. These tests indicated that moderate firing pressures at low compression ratio resulted in improved cruise BSFC, thus indicating the possibility for considerably reducing the specific weight of a diesel.

In conclusion, the results of the near-term conventional engine activities have shown that it may soon be possible to improve both economy and cooling efficiency. Since the technology is being developed in terms of current production engines under the constraint of remaining compatible with existing facilities, processes, etc., it can be incorporated into OEM production with little adverse effect. By the same token this technology is potentially available for incorporation by retrofit.

Farther into the future it appears that the internal combustion engines discussed today are all viable candidates. They have the potential of improving significantly on the present situation in terms of fuel economy, weight, alternative fuels capability, and other characteristics. In addition to these readily quantifiable benefits, there are further benefits in the areas of safety and all-around utility. Over-the-weather cruise altitude capabilities could eliminate up to 25 percent of all weather-related accidents at the same time it is providing more efficient and comfortable flying conditions. Although the candidate engine selection process will be difficult, it is anticipated that a preliminary selection may be possible after comparative engine/airframe results are in hand. However, regardless of which candidate is selected, the potential powerplant advancements are synergistic with expected improvements in structures, aerodynamics, materials, and avionics which together will result in significantly improved airplanes for the 1990's and beyond.