ITEM NO. 4, 5 & 25
FILE NO. XXXI-8

PLASTICS AND WOODEN PARTS IN GERMAN AIRCRAFT

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COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE

LONDON—H.M. STATIONERY OFFICE

REPORT ON

PLASTICS AND WOODEN PARTS IN GERMAN AIRCRAFT

(A limited study based on observations at the Dornier, Messerschmitt and Heinkel Aircraft Plants)

Reported by:

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On behalf of

U.S. Technical Industrial Intelligence Committee

CIOS Items 4, 5 & 25
Rockets and Rocket Fuels
Jet Propulsion
Aircraft

COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE
G-2 Division, SHAEF (Rear) APO 413

PLASTICS AND WOODEN PARTS IN GERMAN AIRCRAFT.

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SUMMARY

In order to conserve metal, especially aluminum, and to reduce production time, the German aircraft industry had developed several semistructural and structural parts in wood. The boldest venture in this direction, which is here reported, is the all-wood wing of the He-162. Wooden parts of lesser importance were found on the Do-335 and the F-W-190 and Me-262.

A new type deicing boot which comprised resistance wires embedded in a plastic sheath was also of interest. An early installation had been made on the Do-335.

A new and exceedingly interesting "sealer" or lacquer had been developed by I.G. Farbenindustrie and applied by Heinkel. This was Polystal, a di-isocyanate resin which was used to seal the integral gas tanks in the wing of the He-162.

No radical or startling applications of molded plastics were uncovered.

INTRODUCTION

In order to ascertain the new developments in aircraft parts of wood and plastics, the chief engineers of several aircraft companies were interrogated and one of the leading designers of wooden aircraft in Germany was also interrogated. A limited number of selected targets were also investigated.

CIOS Targets Nos. 25/250. 5/11.

25/196.

REPORT I - THE USE OF WOODEN AND PLASTIC AIRCRAFT PARTS IN DORNIER AIRCRAFT

Personnel Interrogated

At Manzell and Ravensberg -

Herr Flittiger, Chief Design Engineer
Herr Goetsch, Purchasing Agent

At Richenbach -

Herr Bauer, Model Supervisor
Herr Brombeiss, Assistant Plant Manager

Results of Interrogation

In addition to the customary applications of plastics, such as plexiglas closures, molded phenolic instrument housings and knobs, thermoplastic cable insulation, adjustable collar-button cable binders, molded plastic accessories, and plywood access-doors, the Dornier engineers had developed several interesting applications of wood and plastics. These included a metallized screen or shield on the interior of the housing for the directional aerial 1) of the Do-217, a special plastic de-icing boot and special plywood leading edges for the wings and fins 2) of the Do-335.

Observations

The housing for the directional aerial of the Do-217 was formed from plexiglas and in itself it was not outstanding. However, on the internal surface of this housing a metallic shield had been applied by a metallizing process. The shield was in the form of a sunburst with twenty-four radiating rays, each about 3/4" wide. The center was about 6" in diameter. The workmanship was very good and the edges were so exact that the metallizing must have been applied through a cut-out shield. An experimental housing was found in which the shield had been applied with conductive paint. The metallized coating was much less than 1 mm. thick and appeared to be aluminum.

1) Note: See Photograph I.
2) " " " II and III.

The spedial de-icing boot was comprised of a web or mesh of resistance wire embedded in a thin layer of plastic material. It was stated by Herr Flittiger that the plastic material was 7 mm. thick on the wings and fins of the Do-335. The plastic sheet was cemented to an aluminum back. The plastic composition was known as "Oppanol". The advantages of this boot were simplicity of attachment and the flexibility in design. A complete report on the electrical characteristics of this boot has been prepared by another member of this team, Mr. K. Burnham.

Several wooden semi-structural components were incorporated on the Do-335. These were sections of the leading edge of the wings and the leading edges of the vertical fins, which were constructed of plywood, because they served as radar housings for the night-fighter design.

The design of the parts was completed in cooperation with Herr Eric Bachem, Bachem-Werke, Waldsee, who was one of the outstanding designers of wooden aircraft in Germany.

The plywood sections of the wing were about 9' long and 15" deep at the deepest point. The edges were reinforced with additional layers of plywood and the part was held in place by screws through the reinforced areas. The skin was comprised of 5 layers and was approximately 1/16" in total thickness. The face grain of the veneer was set at 45° to the longitudinal axis of the wing. The structure was reinforced with 8 ribs, each approximately 3/4" x 3/4". The ribs were comprised of 1/8" veneers. The assembly was bonded with "Kaurit WHK". It was stated that these wooden parts could be interchanged with a section of the de-icing boot. The structure of the leading edge of the fins was similar, but lighter. 2) The wing leading edges were fabricated by Kittelberger at Höchst near Bregenz. The leading edges for the fins were fabricated by Bachem-Werke at Waldsee. The fabrication techniques will be discussed in Report VI on the latter factory.

The documents seized at the Dornier plant were the Deutsche Normen Nos. 9138 and 9140 which were standards for Plexiglas and fabrics for aircraft usage.

2) Note: See Photographs II and III.

REPORT II - THE USE OF WOOD AND PLASTIC AIRCRAFT PARTS IN MESSERSCHMITT AIRCRAFT

Observations

At the Munich Municipal Airport a number of wrecked Me-262 aircraft were inspected. It was observed that in these aircraft plywood access-doors were used interchangeably with metal doors. This is especially true of a large access-door on the side of the fuselage which opened into the radio compartment. The plywood doors were constructed of a piece of formed plywood, 1/16" thick, reinforced around the edges with a strip of pine, approximately 3/4" x 1/2". Some doors also had reinforcing ribs. The interior surfaces were lacquered to reduce moisture penetration.

It was also noted that the instrument panels and the control panels on the sides of the cockpit were constructed of plywood, approximately 1/2" thick. This represents a very marked decrease in the quality of German aircraft and points to serious production difficulties and shortages.

The leading edge of the fins and the stabilizers on some of these ships were also of wood construction.

At the Messerschmitt dispersals visited in southern Germany no plastic or wood parts were observed.

CIOS Target No. 5/117 and T/O's

REPORT III - THE USE OF WOOD AND PLASTIC AIRCRAFT PARTS IN THE HEINKEL 162 - A NOTE ON THE ORGANIZATION MAY (PROGRAM SALAMANDER)

Personnel of the Heinkel Organization who were interrogated:

At Innsbruck (M 48/D 75) on 7-7-45. Hotel Hungerberger.
Dr. Karl Schwärzler, Chief Designer.

At Jenbach (M 48/E 07) on 7-7-45. Heinkel Plant.
Herr Paul Pantke, Technical Director of Subcontracting (Vienna)
Herr Anton Grassinger, Director of Jenbach Plant.

Personnel associated with Organization May who were interrogated:

At Esslinger (L 49/S 11) on 6-30-45. Staatliche Ingenieur Schule.
Professor Heinz Prinz, Experimental Design Engineer.

At Ebersbach (L 49/S 31) on 6-30-45. Holz and Metallbau G.m.b.H.
Herr Rogmann, Purchasing Agent for Organization May.

At Biberich (L 49/X 54) on 7-3-45. Schwäbisher Formholz G.m.b.H.
Herr Fritz Armbruster, Technical Director.

At Kaufbeuren (M 48/Y 12) on 7-12-45, Schwäbisher Formholz G.m.b.H.
Herr R. Newwirth, Engineer.
Herr D. Sost, Engineer.

At Isny (L 48/X 70) on 7-8-45. Heim-Werke G.m.b.H.
Herr Wilhelm Heim) co-owners
Herr Richard Heim)
Herr Amende, Engineer and Draftsman, Organization May.

Results of Interrogation

Interrogation of personnel of the Heinkel Organization disclosed the fact that the Heinkel No.162 airplane was partly designed in wood to conserve aluminum and to reduce the number of man hours required to produce the aircraft. The design was reported to be a compromise and was chosen from several designs submitted

by the leading German aircraft manufacturers in compliance with a request and specifications sent out by R.L.M. Dr. Schwärzler reported that the competition was very keen and that the Heinkel design was chosen, because it provided the greatest possibility for the use of standard aircraft parts, such as landing gear, which were already in production.

It was reported that the following parts of the aircraft were fabricated from wood: the wings, the wing tips, the nose, the vertical fin, the ailerons, and the instrument panel. To expedite the production of these parts, a group of subcontractors were organized into an interlocking production system known as Organization Mäy, under the direction of Dr. Kurt Mäy. This organization was primarily concerned with the fabrication of the entire wing of the aircraft.

The design work on these wooden parts was carried out in Vienna under the direction of Dr. Schwärzler. Intermediate design change, subsequently introduced to overcome production difficulties, were made at Ebersbach by Herr Amende. These changes only affected the production of Organization Mäy.

Dr. Schwärzler reported that the wings were designed to have a load factor of 11.2. The static test of the wooden structure yielded a value of 100% of the design load. The design criteria were taken from the standards on plywood set by the R.L.M. These criteria are given in two brochures seized at Ebersbach entitled, "Kiefer in Flugzeugbau" and "Prüfvorschriften für Tragflügel No. 162, and in the Deutsche Normen on plywood.

Other organizations besides Organization Mäy contributed to the production of wooden parts for the Heinkel No. 162. These were reported to be Schaffer in Linz, "Wärzhter in Zeubenroda, Behr in Sprengen, and Amme, Luther and Seck in Lend. These companies are mentioned in a pamphlet seized in Ebersbach entitled, Programm Salamander. This document was marked "Geheim".

The flat plywood panels used by Organization Mäy were supplied by the Wechter Organization which was set up to handle all aircraft plywood. Formed plywood was supplied by Behr in Sprengen near Wendlingen.

In Appendix "A" a photostat of the breakdown of Organization Mäy is included.

Observations

All the plywood used in the aircraft was Tego-bonded. The veneer was red beech. The spars and ribs were pine, either massive or laminated. The curved sections of the leading edges of the wing were comprised of 3 layers of 3-ply plywood bonded together with "Kaurit-W". The forming was accomplished in "pressholz" dies under a pressure of approximately 3 Kg/cm.^{2}, applied mechanically. The resultant total thickness was approximately 5 mm. The remaining surfaces of the wing were covered with flat panels of plywood which contained 5 plies. The wing covering was comprised of 3 parts which were boned together at scraf joints with "Kaurit-W". The assembly of the internal structure of the wing was also accomplished with "Kaurit-WHK".

Further, since the central section of the wing was used as an integral gas tank, the interior was sealed with "Polystal", a poly-di-isocyanate resin manufactured by the I.G. Farbenindustrie at Leverkusen. This sealer made the plywood impervious to aircraft fuel and since the resin had a low modulus of elasticity it withstood vibrational stresses very well.

Dr. Schwärzler stated that the Heinkel plants had built 120 planes and that about 300 sets of wings and fins had been delivered to the firm by the subcontractors. This was confirmed by Herr Pantke.

Professor H. Prinz was working on the design of a simplified wing-covering for use by Organization May. His results are reported in a document seized at Ebersbach entitled "Schalenintwicklung No 162 - Bauart Esslingen." It was reported by Herr Rogmann that this method was never put into production.

When questioned regarding the relative merits of wood and metal aircraft components, Dr. Schwärzler stated that if a wood and metal part, a wing, were each designed for the same load factor, the wooden structure would be 20% heavier than its metal counterpart.

It was also stated by Dr. Schwärzler that the wings of several previous Heinkel designs had been made of wood. These aircraft included the He- 59, He-60, He-70, and He-116. The unimportant parts of the He-170, a new design, were fabricated in wood. These included the access-doors.

The Heinkel designers had for a long time attempted to incorporate wooden parts on their aircraft, but

Dr. Schwärzler stated that metal was more suitable for aircraft production because of its greater uniformity.

Documents

See Appendix "A".

No blue prints on the construction of the wing of the He-162 were available.

CIOS Target No. 4/217

REPORT IV - THE PRODUCTION OF WOODEN AIRCRAFT PARTS AT THE BACHEM-WERKE

Personnel Interrogated

At Waldsee (L48/ x 52) on 7/11/45
Herr Eric Bachem, Owner.

Results of Interrogation

Herr Bachem, who by his own admission was one of the outstanding designers of wooden aircraft in Germany, had worked and consulted on the wooden parts for the Do-335, the He-162, and the "Nattar".
Natter

Observations.

His plant was producing the leading edge of the fin for the Do-335. Flat plywood panels, cross-bonded, we purchased and fabrication of the components was accomplished by glueing the panels together in "pressholz" or hard maple molds using "Kaurit-WHK" glue and elevated temperatures. The shell of the leading edge was formed by assembling the plywood panels in the molds and forming and curing at 180°C. No accurate estimate of the pressure was given, since the pressure was applied through screw clamps. The ribs were cemented into the shell in a special jig. Hoops or bands for the fuselage of the "Nattar" were also fabricated in this plant. These were laminated from thin veneer and were made as continuous loops or as hemi-sections which were later joined by scarfing and cementing. Wing tips of plywood were also fabricated for this ship. This program had been investigated by the A.T.I.

Documents

No documents were seized.

REPORT V - PRODUCTION OF AIRCRAFT AT THE FIRM OF J. REISS, TETTNANG

Personnel Interrogated

At Tettnang (48/C 39) 6/28/45
Herr J. Reiss, Owner and Plastics Designer
Herr S. Nissen, Assistant to J. Reiss.

Results of Interrogation

The firm of Reiss fabricated the special Plexiglas aerial housing used on the Do-217. 1) A poor grade of plexiglass was used and the parts were formed in metal molds. Herr Reiss stated that he had never used plastics or "pressholz" for molding plastic parts. Examples of this aerial were found in which the metallic "sunburst" shield had been painted on the interior of the housing with conducive paint and also some in which this metallic shield had been applied by the metallizing process. The latter were on production ships. Herr Reiss confirmed the use of metallizing in applying this shield. He did not know where the metallizing was done.

Observations

This firm also made a housing for radio equipment for the Luftwaffe. This was a right cylinder 6" in diameter and 10" high. It was fabricated of opaque white Astralon. A rectangular tube 2" x 4" of clear Astralon projected tangentially from the side of the cylinder. Herr Reiss disclaimed any knowledge of the purpose of this container. A stock of approximately 300 parts was on hand

Mücke?

The firm also produced plastic sinks and nameplates for the Luftwaffe.

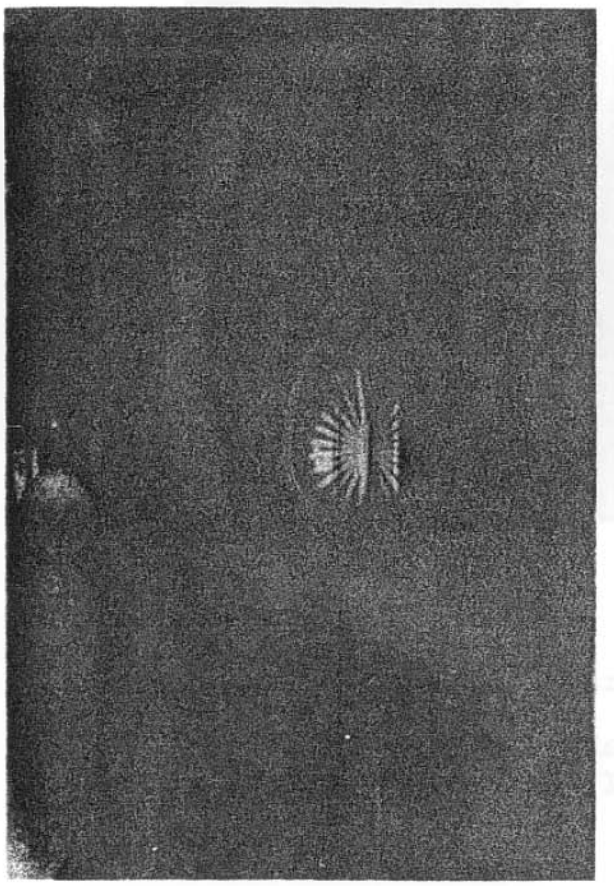
For the Reichsbahn they produced 250 water tanks of welded Astralon. The welding method was apparently that described in a T.I.R. Report.

Documents

The only document seized was a brochure describing the above-mentioned parts with the exception of the aerial housing.

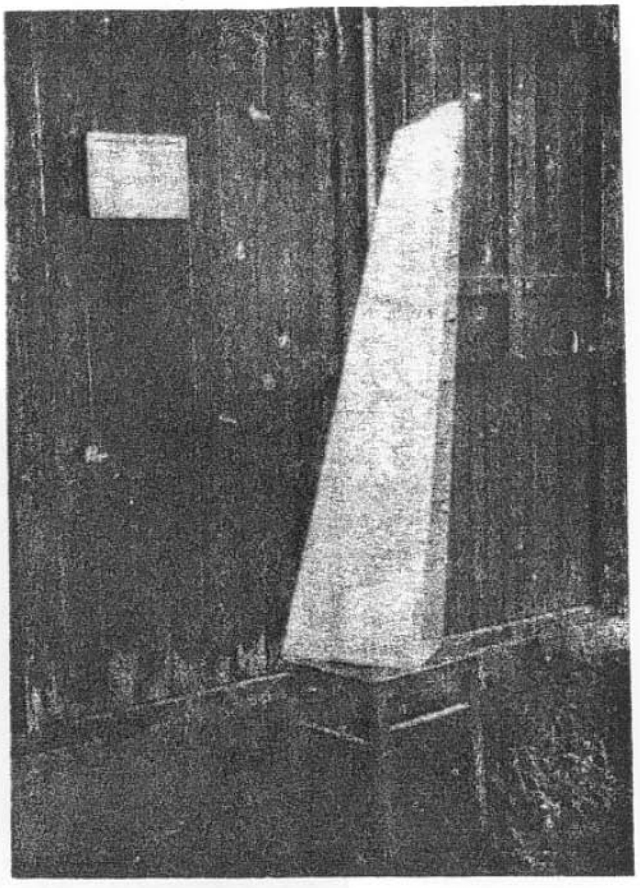
1) Note: See Photograph I.

PHOTOGRAPH I.



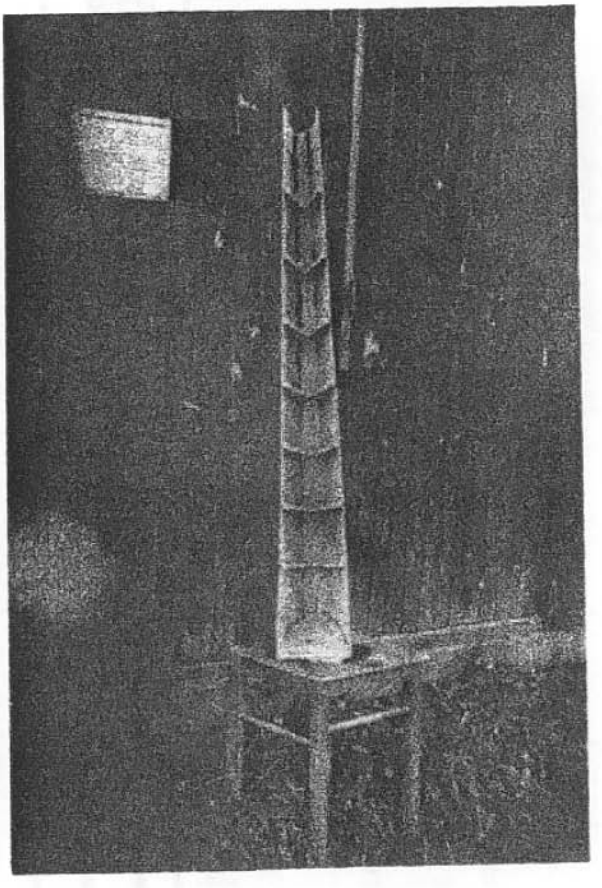
Directional-Aerial Housing
Dornier Werke, Manzall
Plexiglas with shield applied by the
"Metallizing" process

PHOTOGRAPH II.



Leading Edge of Vertical Fin
for Do-335
Bachem-Werke, Waldsee
Laminated, shaped plywood.

PHOTOGRAPH III.



Leading Edge of Vertical Fin for Do-335
Bachem-Werke, Waldsee
Laminated, shaped plywood

36-233-O 18/1/46 B.P.CO.LTD.

Geheim! N. 7

Arbeitsstab Dr. May

Organisation May

- Penz
- Mang

Rippen

- Renz, Böblingen — H.L.
- Burkhardt, Mossu — L.I
- Haid, Pfullingen
- Mantsche, Thalheim
- Taxis, Holzelfingen
- Hack, Ohmenhausen
- Maier, Betzingen
- Haid, Schw. Gmünd — L.II
- Schürle, Lamingen
- Schmid, Domsdorf
- Schock & Co. Schorndorf
- Pfleiderer, Schorndorf
- Mang, Baden-Oos — L.III
- Hauser, Kirchzarten

Holme

- Südd. Möbelindustrie, Göppingen — H.L.
- Münz, Frommern — L.I
- Renz, Böblingen
- Grimm & Mössner, Göppingen
- Notdurft, Göppingen
- Decker, Ehingen
- Leicht, Gmünd-Waldstetten
- Fink & Ott, Haiterbach
- Sommer, Pfüderhausen
- Mang, Baden-Oos — L.II
- Hehbach & Amman, Wehrenb.
- Hund & Rohm, Wolfach
- Holzindustrie Steelher, Bötenheim

Formteile

- Behr, Wendlingen — H.L.
- Schwäb. Formholzges., [illegible]
- Ritter, [illegible]
- Schildknecht & Co. Stgt.
- Linder, Nürtingen
- Gross, Urach
- Backsteiner, Singen

Querrud. u. Landekl.

- Straub, Kalttlingen — H.L.
- Bühl, Langenbrücken
- Lepper, Wiernsheim
- Blum & Schäfer, Wiernsh.
- Fried, Fellbach
- Behr, Wendlingen — L.I
- Renz, Böblingen — L.II
- Mang, Baden Oos
- *[illegible] Kirchheim*

Beschläge

- Kärcher, Winnenden — H.L.
- Zimmermann, Rottenbg. L.I
- Rauch, Rottenburg
- Pulvermüller, Rottenburg
- Heilig, Rottenburg

Tragflächen-Zusammenb.

- [illegible] Asberg — H.L.
- [illegible], Böblingen
- [illegible], [illegible]-Nagold
- [illegible] Renz, Aug.
- [illegible] Esslingen —
- [illegible] Backnang —
- [illegible] Linkenheim
- [illegible], Schorndorf