Proposals for a Simplification of
Electric & Electronic Wiring
and Accessories for the
C105 AIRCRAFT

DA 439.

Ref: 3722/02B/E

July 12th, 1954.

UNCLASSIFIED

PROPOSALS FOR A SIMPLIFICATION OF ELECTRICAL AND ELECTRONIC WIRING AND ACCESSORIES FOR THE C105 AIRCRAFT

Classification cancelled/changed to.....
by authority of.....(date).....
Signature.....Rank.....

A.V. ROE CANADA LIMITED
AIRCRAFT ENGINEERING DIVISION

USAF approval for use on guided missiles provided proper crimp + pullout tool used.

Taper pins – Used on certain circuits of Matador (Guided missile)

Used on IBM business machines

Dayton authority to use on Matador up to size 16

(Connectors having over size 16 will have solder pots in addition to taper pin facilities for small cables

Taper pins tested to 185°F (same as connectors)

(Pull out force increase considered due to migration of molecules over contact area)

No aircraft installations at present

(North American may be carrying out tests

RCAF

Consider taper pins should be tested under aircraft operating conditions (CF-100) prior to acceptance.

Electrical and Electronic Systems in any aircraft are dependent on the required equipment selected for their own requirements and those of other aircraft services. By careful consideration of cost, weight, reliability, service and space requirements, equipment can be selected which will be the best compromise for installation in the aircraft. Similarly when installing the necessary wiring for Electrical and Electronic Systems, careful consideration should be given to the same factors that governed the selection of equipment. For improvements to the aircraft wiring the following proposals are therefore submitted.

1. Simplified Wiring Identification - Appendix "A"

It is believed that this simplified system when applied to Electrical and Electronic wiring will result in a saving of manufacturing time and scrap and therefore cost, saving of engineering manhours and expense, without penalizing servicing requirements. The present coded system having grown to such an extent due to multiplicity of circuitry, has lost its original intention of making easy identification of wiring in the aircraft possible by means of coded idents. We believe the proposed system to be infinitely superior. However, should the purchaser desire a revision to the existing system, the latter could be applied much more readily to a production aircraft, than it can be incorporated in the initial design stage.

2. Use of Taper Pins in lieu of Soldered Wiring Joints and Eyelet Terminals where possible

With existing information on hand at present and subject to approval testing of the Taper Pin terminals under actual expected aircraft conditions, we believe that the adoption of Taper Pins in aircraft wiring would result in a great reduction in installation time, scrap, improved reliability, especially at higher temperatures and an appreciable increase in reliability with greater ease of application of mods when necessary, for the following reasons.

Present "AN" "E" type connectors can be modified by the manufacturers to fit Taper Pins and with the design or purchase of a suitable Taper Pin Terminal Block, wiring, manufacture and installation would then be the same about 95% of the time, instead of about 70% as at present. However this would not change the selected equipment since these modified connectors will still mate with units equipped with the present connectors. If desired for service reasons in the field, a normal connector could readily be used by soldering, if an unmodified one were not available. The application of the taper pins on the wire and installation in a connector or terminal block should result in a saving of time and cost over the soldering of wiring in connectors and use of eyelet terminals on Terminal Blocks. Also a more constant quality joint is made with taper pins because soldered joints depend on the skill and experience of the individual to a much larger extent.

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Use of Taper Pins makes possible the changing of wires in the aircraft, a facility which is dangerous and very time consuming when solder is used.

When installing wiring in wings or other critical areas of structure, smaller holes in structure may be used with consequent reduction of reinforcing plates or gauges of metal or a weight/space reduction as per the following example:

> 120 wires, without fittings, average 1 lb. per ft. and measure approximately 1½" diameter. If connectors are attached, 3½" diameter holes would be required through structural members wherever the cables must pass. Similarly conduit diameters must be increased accordingly. The alternative method in use at present, when space is limited, is to run the cables without connectors to terminals strips, and to add extra cables with connectors from there to the units. Existing terminal strips and eyelet lugs, add approximately 3 lbs. per hundred to the weight of wiring. When located throughout the aircraft the space taken would be 10" X 10" X 14" per hundred terminals; also accessibility must be available for mounting and circuit inspection for each wire after installation.
>
> Should connectors with Taper Pins be used for the same quantity of wires; the wires with their crimped tips, but without connectors, may be passed easily through 2" holes for the complete run to the equipment. The connectors may then be added to the cables and plugged directly into the units.

3. Taper Pin Terminal Blocks

If the design of a Taper Pin Terminal Block also meets approval, much space and weight will be saved when wire must be paralleled. Also the wire tip and installation tool for terminal block connections will be the same as for the connector. With our flexible wire ident. system, serviceability is greatly increased.

4. O - Ring Bulkhead Sealing

O-Ring sealing for pressure bulkhead connector installations, to replace the slow process of applying sealing compounds. This method, together with the use of Taper Pins, eliminates the need for "T.B.F." fittings to improve serviceability. "T.B.F." fittings would add approximately 35 lbs. if used for the cockpit floor disconnects.

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5. A Proposal for Simplified Cable Clipping - Appendix "B"

To date, clamps used for the electrical cables on our A/C are not adjustable, and the quantity of wires in each clamp may only be altered within very narrow limits. Therefore clamp part numbers and drawings must be changed throughout for additions to existing cable runs and many sizes must be stocked.

Boeing Aircraft save much time and money by simply tying their cables to "Tombstones" (moulded nylon brackets which serve as hitching posts).

The accompanying sketch shows a cable support bracket to be fastened in the A/C by one or two mounting bolts, or rivets. Two sizes only are indicated: one for a normal cable run location, into which almost any size or number of cables may be laid; and a small clip to be located where space is limited and the cable would not be large. If, and as required, the cable would be wrapped with protective tape or tubing. When any or all the required cables are placed in their clips they may be securely tied with cord in an approved manner.

The cord used should tie well without stretching and must fulfil the same requirements for extreme atmospheric conditions as the cable and clips.

By comparison with the Adel Clamp and the "Tombstones", this clip supports a heavy cable in most mounting positions without being fastened, also long runs could be "laid in" before any clip is tied.

By comparison with both Adel and Madanock clamps, this bracket serves a very wide range of cable sizes; and the cost should be considerably less.

General Comments

These measures for the simplification of the design and installation of the aircraft wiring have already received the support of planning and production, and we sincerely hope they will be received by the R.C.A.F. with as much enthusiasm for their approval, as we feel in submitting them.

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Cable Identification

NAVAIR proposed not acceptable (Training aspect of personnel and equipment identification

With concessions granted NAVAIR at present there is no reason why the MIL-W-5088 identification system should present a problem during construction or modification of aircraft.

Pointed out to NAVAIR that sequence letter more practical should be in sequence, however redundant cables or key words may affect this sequence when redundant cable used.

NAVAIR permitted to type identify cables and functions when redundant wires used on aircraft for mock, and also on cable assemblies already purchased but not installed until such time as production changes can be made on new cable assemblies and drawings.

When redundant cables are reused & remarked changes must be made on drawing which accompanies aircraft.

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APPENDIX "A"

A PROPOSAL FOR THE IDENTIFICATION OF AIRCRAFT WIRES

The purpose of the identification system outlined is to achieve simplicity and flexibility, together with the individual "Identing" necessary for each wire installed in the aircraft.

With the existing MIL-W-5088 system, the prefix letter used represents any one of perhaps seven or eight circuits in a particular group; therefore the purpose of a wire cannot be ascertained without the use of a drawing. In general, aircraft wiring is so complicated that wiring diagrams are essential to ascertain the purpose or function of individual wires.

If the MIL-W-5088 numerical and letter sequence is to be maintained, the "identing" must be reworked constantly during the time the drawings of the wiring installations are in progress, in order to keep in line with the normal circuit design changes. Eventually the numerical continuity "breaks down" to some extent. Therefore it is an unsafe practice to "follow" a wire run in the A/C by the sequence of the idents, without reading the drawing. Also a wiring run from one end of the aircraft to the other may become redundant because of a modification. Simultaneously, an additional wire of the same size, running to the same location may be required for another circuit. Under the present system, the redundant wire, of the correct size, cannot be used because it has a different prefix letter. All those who are experienced with electric systems know that it is not an exaggeration to say that possibly six long cable runs and three junction panels might be removed from the aircraft to make the change.

Good design practice requires allowance of connector pins, terminals, and space for the addition of wires throughout the aircraft. Experience has proved that the terminations left vacant are always used eventually. Many cables particularly in prototypes and early production are reworked (and often removed from the aircraft) four or five times, because the wires must be added two or three at a time as required for circuit additions.

Often we have been asked if it would be possible to include the spare wires in the original cable assemblies, using past experience as a guide in selecting the wire size most likely to be required and which would serve satisfactorily for the majority of circuits. This could be done very easily if it were not necessary to consider the letter prefixed for the different groups of circuits.

Therefore the following system of identification is proposed:

The letter "E" (for electrical system) separates the wire number (from 1 to infinity) from the wire size. For example "165E16" means wire #165 belongs to the electrical group and is size AN16.

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Similarly 205R20 means that wire #205 belongs to the Radar-Radio group and is size AN20.

It would be definitely understood that no particular numerical sequence need be maintained.

The suffixes A, B, and C have been eliminated. If the phase loads must be rebalanced, it is a simple matter to alter the phase supply for a particular load; but most difficult to rework a long cable run in order that phase identification of one wire may be changed. The use of the letter "N" for a ground wire also creates inflexibility and will be eliminated.

The proposed system means that, once a wire has been installed in the aircraft, it may be used and connected into any desired circuit, as long as the size and length are correct. Thus in many instances cable assemblies may be installed complete, and all circuit additions, deletions and changes may be made at local points of distribution.

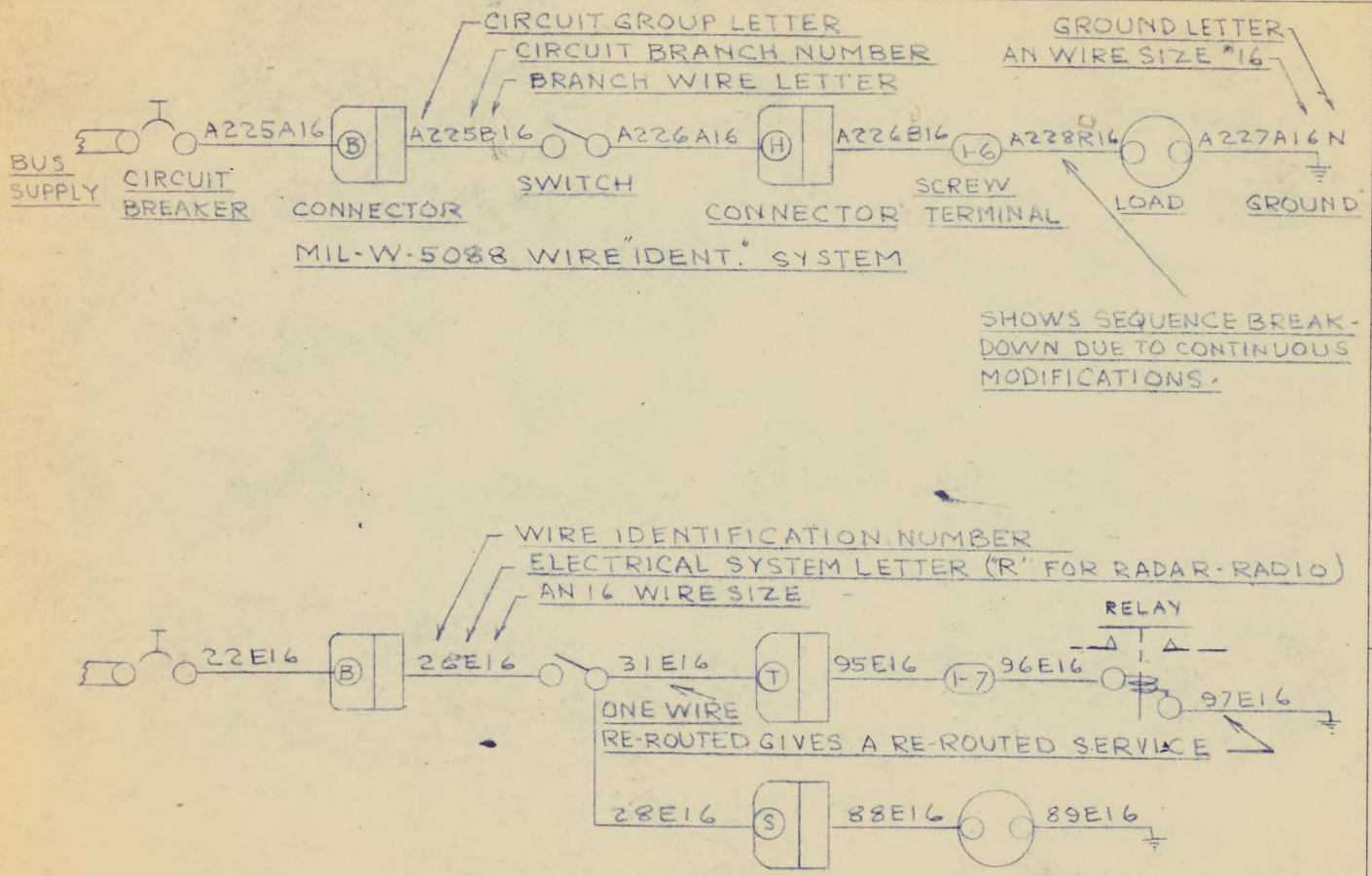
It will be most advantageous if wires which have been installed and inspected, can remain in the aircraft. Also to throw away a wire because of a change in identification is expensive in man hours and the quantity of "spares" required for servicing.

With the beginning of a new aircraft design this system would greatly simplify the design of all wiring. Each wire or group may be numbered whenever convenient, without regard for the finalized circuits, which are often dependent on the unpredictable changes in requirement, bought-out and Government furnished equipment, etc. The simplified system thus saves many man hours in drawing time.

It is presented for the consideration of all concerned and the hope that it will meet with approval.

Since this coding system represents a deviation from MIL-W-5088, R.C.A.F. approval will be required.

FORM 1719A



A V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: SEE-APPENDIX-"A"

REPORT NO. REF.3722/023/8

SHEET NO

PREPARED BY

DATE

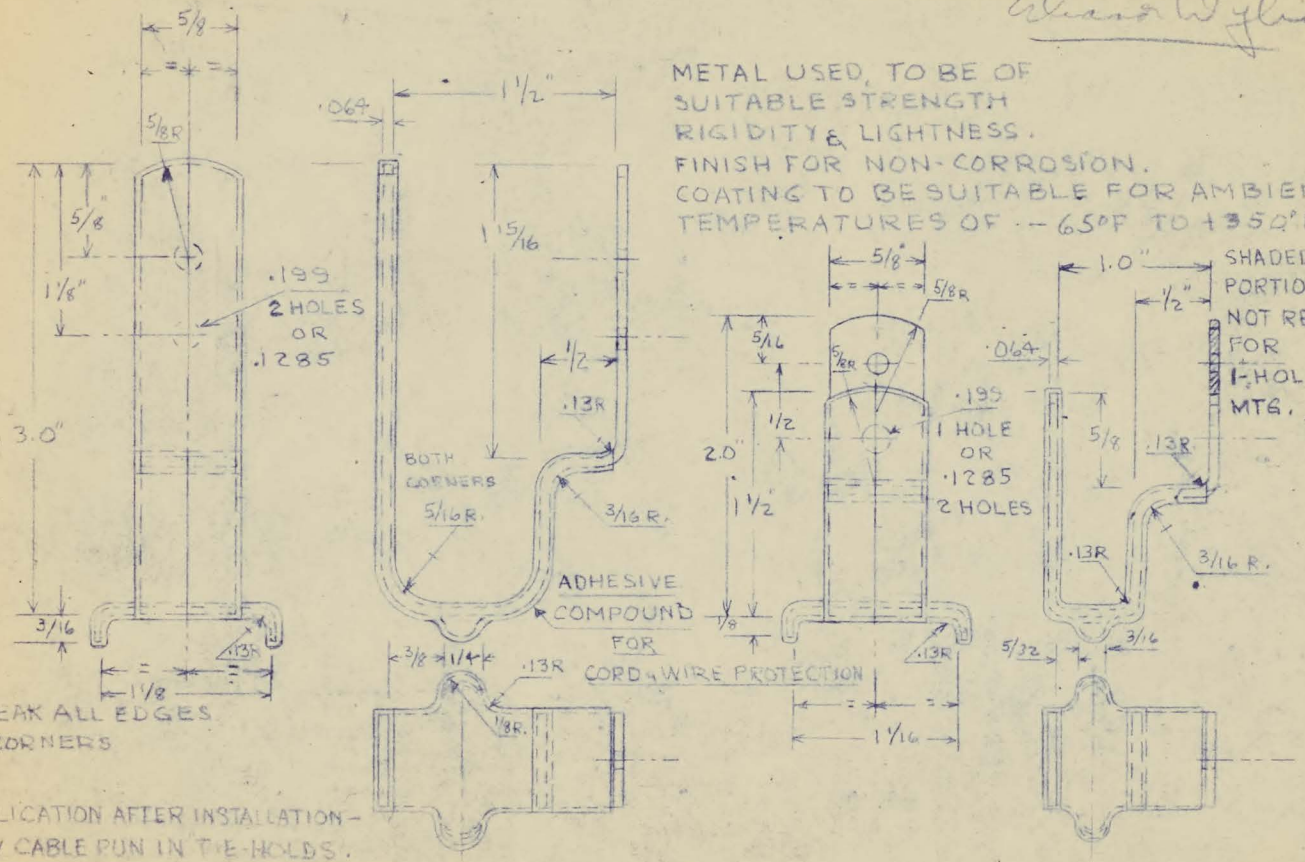
DATE

UNCLASSIFIED

ORM 1319A

THE "TIE-HOLD" - ELECTRICAL CABLE SUPPORT.

Eleanor Wylie



METAL USED, TO BE OF SUITABLE STRENGTH RIGIDITY & LIGHTNESS. FINISH FOR NON-CORROSION. COATING TO BE SUITABLE FOR AMBIENT TEMPERATURES OF -- 65°F TO +350°F

APPLICATION AFTER INSTALLATION -

1. LAY CABLE RUN IN TIE-HOLDS.

2. WRAP CABLES IN PROTECTIVE COVERING OF APPROVED MATERIAL IF REQ'D. FASTEN CABLES WITH APPROVED CORD. TIE AROUND CABLE, TABS AND BEND IN CLIP, AND AROUND FRONT OF CLIP ACCORDING TO THE SIZE OF THE BUNDLE. TIGHTEN SECURELY AND TIE APPROVED KNOT.

A. V. ROE CANADA LIMITED
MALTON ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. REF. 3722/0228/2

SHEET NO

AIRCRAFT: THE "TIE-HOLD"
A UNIVERSAL CABLE SUPPORT BRACKET
SEE-APPENDIX "B"

TO HOLD VARIOUS QUANTITIES OF WIRES

UNCLASSIFIED

PREPARED BY	DATE
E. WYLIE	OCT 16/53
CHECKED BY	DATE