



C. of A. NOTE No. 38.

Appendix B.

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THE COLLEGE OF AERONAUTICS

C R A N F I E L D

A NOTE ON SURFACE GRINDING

Stayblade, in the fully hardened and
tempered condition UTS, 80 tons per
sq. in., V.P.N. 390.

This note is prepared as an appendix to College of
Aeronautics Note 38.

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SUMMARY

The investigation carried out into surface grinding Stayblade shows that this material presents severe conditions to the grinding wheel, and the grinding wheel face is broken down fairly quickly.

The method described in C of A Note 38 for wheel and coolant selection and development enabled the total wheel face life to be improved from 0.105 cubic ins. to approximately 10.00 cubic ins. per redress with acceptable surface finish.

The use of soluble types of coolants would appear to be much less efficient than cutting or grinding oil coolants and the following combinations were found best:-

Wheel:- Carborundum 7.D.A.60 I 5 VF BUJ.

Coolant:- Manchester Oil Refinery DOLPHIN MC OIL.

Wheel life is 3.5 cubic ins. per redress for 7 ins. dia. by 1 in. wide wheel.

The addition of 5% Wynns friction proofing fluid showed 200% increase in wheel face life with acceptable surface finish.

CONTENTS

<u>Summary</u>	Section
Selection of an efficient grinding wheel	1
Selection of an efficient coolant	2
Estimation of wheel face life	3
The effect of coolant additive on wheel face life.	4
Results Sheets	5

The equipment used in the test programme is described in C of A note 38 Section 1 Page 3.

SECTION 1

1.1 Selection of an efficient grinding wheel.

The techniques and method described in detail in C of A Note 38, Section 4 page 9 and Appendix A Section 1 were used to evaluate the efficiency of the grinding wheels tested.

Initially the coolant used was a soluble oil in water 1 vol. in 20 of water. The results of the tests using this coolant proved unsatisfactory; the wheel face life in all tests was far too short for practical evaluation.

From the large number of wheel specifications tested (see Results Sheet No. 1) the best were selected, and further selection tests carried out using Manchester Oil Refinery DOLPHIN M.C. oil as the coolant. This gave much better results, see Results Sheet No. 2. The wheel which gave good face life together with acceptable surface finish was Carborundum 7D A60 I5 VF BIU. Modifications to the wheel specification as described in Note 38 Appendix A Section 4 were made; these improved total stock removed i.e. wheel face life, but surface finish suffered and the final choice remained as follows:-

Wheel specification

Carborundum Grinding Wheel Co.

7.D. A.60 I5 VF BIU

Test Conditions

Test piece:

Stayblade, fully hardened and tempered 80 Tons/sq.in. U.T.S.
V.P.N.390.

Wheel dimensions:

Diameter	7 ins.
Width	1 in.
Surface speed	5,500 ft. per min.
Table speed	50 " " "
Cross feed	0.042 ins./pass
Depth of cut	0.001 ins.

Coolant:

Manchester Oil Refinery DOLPHIN M.C. OIL
delivered at 4 pints per minute.

SECTION 2

2.1 Selection of an efficient coolant.

The methods used to evaluate the 18 different brands of coolants tested is described in detail in C of A Note 38, Appendix A, Section 5. The results obtained from the series of tests are included in Results Sheet 3.

From these results the Manchester Dolphin M.C. oil gives greater wheel face life and best surface finish.

Condition of test

Test piece:

Stayblade, fully hardened and tempered 80 Tons/sq. in.
U.T.S. V.P.N. 390.

Wheel dimensions:

Diameter	7 ins.
Width	1 in.
Surface speed	5,500 ft./min.
Table speed	50 ft./min.
Cross feed	0.042 ins/pass
depth of cut	0.001 ins.

Coolant

Various (see Results Sheet No. 3),
delivery 4 pints per minute.

SECTION 3

3.1 Estimation of wheel face life.

The method of estimating the total wheel face life from data obtained from part life tests as described in Note 38 Appendix A, Section 6 was used.

The estimated wheel face life results are given in Results Sheet No. 4. The estimated life of the best wheel using the most efficient coolant was checked by complete life tests and the results are recorded in Results Sheet No. 5. It will be seen that this method of estimation gives reliable results.

SECTION 4

4.1 The effect on wheel face life and surface finish when using Wynns Friction proofing additive in the coolant.

From the results of tests carried out in Sections 1 and 2 of this Appendix it is found that the most efficient grinding wheel and coolant will give a wheel face life of approximately 3.6 cubic inches per redress. When this volume is compared with that for REX 448 (recorded in Appendix A of C of A Note 38) for which the volume per redress is 20 cubic ins. (under constant test conditions), it is apparent that the grinding conditions presented by Stayblade are very much more severe than presented by REX 448. It was therefore decided to try to improve wheel face life by the use of Wynns friction proofing additive.

Conditions of test

Test piece:

Stayblade, fully hardened and tempered, 80 Tons/sq.in. U.T.S.
V.P.N.390.

Grinding Wheel

CARBORUNDUM 7 DA 60 I 5 VF BLU

DIAMETER = 7 ins.

WIDTH = 1 in.

DEPTH OF CUT = 0.001 ins.

CROSS FEED = 0.042 ins. per pass

TABLE SPEED = 50 ft. per min.

Coolant

(1) Manchester Oil Refinery DOLPHIN MC oil

(1a) With 2 $\frac{1}{2}$ % by volume of additive

(1b) " 5% " " " "

- (1c) With 7½% by volume of additive
- (1d) " 10% " " " "
- (2) Shell Mex B.P. Soluble Oil in Water - 1 volume in 40 water.
- (2a) With 2½% by volume of additive
- (2b) " 5% " " " "
- (2c) " 7½% " " " "
- (2d) " 10% " " " "

The coolant delivery is constant at ½ gal (per minute).

The results of the above tests show marked improvement in wheel face life but no improvement in surface finish.

The above additive referred to is:

Marketed by F.U. (London) Ltd.,

Birkett House,

27 Albemarle Street,

LONDON. W.1.

under the trade name of

WYNNS FRICTION PROOFING FLUID.

Summary of results for coolant plus additive tests

Coolant	% additive	wheel face life	Surface finish CIA
MANCHESTER OIL			
PRIMOR MC	NONE	3.55 cu ins.	9
"	2½%	6.56 " "	17
"	5%	8.87 " "	12

Coolant	% additive	wheel face life	Surface finish CIA
PRIMOR MC	7 $\frac{1}{2}$ %	9.310 cu ins.	14
"	10%	9.247 " "	13
SHELL M3			
SOLUBLE OIL			
1 VOL. in 40 VOLS.			
WATER	NONE	0.105 cu ins.	14
"	2 $\frac{1}{2}$ %	0.172	17
"	5%	0.280 " "	8-10
"	7 $\frac{1}{2}$ %	0.550 " "	8-10
"	10%	0.560 " "	9

SECTION 5.

RESULTS SHEET NO. 1

List of all wheels tested

Abrafract Grinding Wheels

- A80 - NB - 919
- A80 - NB - 930
- A80 - NB - 930 - 3 - 258
- C46 - LMB - 19
- C100 - OB - 19
- A80 - FB919 - 3 - 194
- A80 - OB919 - 3 - 194
- A80 - NB930 - 3 - 258

RESULTS SHEET No.1 (Cont'd)

Anglo Wheel (GC60 - KV)

Norton Grinding Wheels

38 - A60 - I8 VBE

38 - A46 - I8 VBE

Carborundum Grinding Wheels

7A69 - 15 - VF8

GC80 - J x 5 - VG

GC120 - J5 - VG

7DA60 - J5 - VFBIU

GC80 - JH - VR

GC80 - KH - VR

7A60 - 15 - VF8

7A60 - J5 - VF8

GC80 - K8 - VR

GC100 - K8 - VR

7DA60 - 15 - VFBIU

Universal Grinding Wheels

CH - 100 - IV

A - 36J - V

C - 36J - V

WA - 80 - IV

WA - 60J - V

WA - 120 - HP4

WA - 46H - V

RESULTS SHEET NO.1. (Cont'd)

WA - 46 - JV

WA - N - V

C60 - KP - 4V

C46 - I - V

C - 60J - V

WA - 60H - V

J100 - IV

RESULTS SHEET NO. 2.

Experiment: Wheel Selection Test for grinding, Stayblade.

Remarks: Coolant Manchester Oil Refinery
Dolphin M.C. Oil

Wheel Specification		Surface finish		Wheel wear		Estimated wheel life	
				A	B		
Carborundum	G.C.120 J.5. VG	9	MICRO Ins.	0.044	0.290	1.448	cu. ins.
"	7.A.60 I.5. VF8	10	" "	0.048	0.170	2.810	" "
"	G.C.80 J x 5 VG	9	" "	0.024	0.375	3.04	" "
"	7.D.A60 I5 VF BLU	9	" "	0.024	0.200	3.550	" "
"	G.C.80 K11.VR	7	" "	0.036	0.350	2.890	" "
"	G.C.80 K11.VR	14	" "	0.024	0.295	3.786	" "
Universal	UNL. C.100 I.V.	6	" "	0.049	0.175	2.355	" "

RESULTS SHEET NO.3.

Experiment: To select an efficient Coolant for grinding Stayblade.

Remarks: Wheel Specification 7.D.A.60.I5 VF BIJ (Carborundum)

Coolant	Surface finish	Wheel wear		Estimated life
		A	B	
Manchester Oil Refinery DOLPHIN M.C.	9 micro ins.	0.024	0.200 ins.	3.55 cu. ins.
Fletcher Miller Swift H	18 micro ins.	0.028	0.325 "	2.79 " "
Sternol Tapoyl	14 micro ins.	0.030	0.260 "	3.1 " "

RESULTS SHEET NO.4.

Estimation of wheel face life from part life test.

Wheel Carborundum 7 D A60 I 5 VF BU

Coolant Manchester Dolphin Oil M.C.

Length of B at stabilisation = 0.200 ins.

Loss on A per unit volume of stock removed = 0.024 ins.

Total width of wheel face = 1.000 ins.

number of unit vols. (.170 cu. ins.) on A = 20

Life in vol. of stock removed in Zone B = 0.150 cu. ins.

Life in " " " " " " A = 3.400 " "

Total estimated life = 3.550 " "

RESULTS SHEET NO.5

Experiment: Actual results of wheel face life to failure on Stayblade.

Remarks: for wheel 7.D.A.60. I5 VF BIU (Carborundum)

Wheel width ins.	surface area ground sq. ins.	Wheel loss Length A	Wheel loss Length B	Surface finish
Start 1.020	438 " "		0.240	12 micro ins.
	1288 " "	0.130		9 " "
	2138 " "	0.310		9 " "
	2988 " "	0.445		9 " "
	3838 " "	0.520		9 " "
	3960 " "	-	0.260 = x loss	

Total surface area covered = 3,960 sq. ins.

Depth of cut = 0.001 ins.

Total volume of metal removed = $\frac{3,960}{1000}$ = 3.96 cu. ins.

Actual life = 3.960 cu. ins.

Estimated life = 3.55 cu. ins.

