

CoA/M/M+P-7

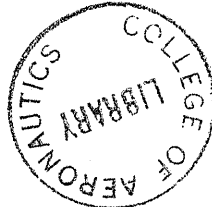


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THE COLLEGE OF AERONAUTICS

DEPARTMENT OF PRODUCTION AND INDUSTRIAL ADMINISTRATION



TEST REPORT NO. PLB0/3

Wear tests on PERPRO tools grade N35/3 and N35/RD25
machining EN 9.

S U M M A R Y

Tools of grade N35/3 and N35/RD25 were tested to .030 in. flankwear at cutting speeds of 500 fpm with 0.010 in/rev feed and 250 fpm with 0.010 in/rev feed and 0.030 in/rev feed machining EN 9. The results showed that N35/3 gave the better performance at the higher cutting speed and that the two grades gave the same performance at the lower speed. At 250 fpm and 0.010 in/rev feed the wear of both grades was mostly confined to a groove at the depth of cut. With the larger feed both grades of tool suffered severe deformation of the cutting edge.

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Test conditions

During the tests EN 9 was machined under the following conditions:

- | | | |
|-----|---------------|---------------|
| (a) | Cutting speed | 500 fpm |
| | Depth of cut | 0.10 in. |
| | Feed | 0.010 in/rev. |
| (b) | Cutting speed | 250 fpm |
| | Depth of cut | 0.10 in. |
| | Feed | 0.010 in/rev. |
| (c) | Cutting speed | 250 fpm |
| | Depth of cut | 0.10 in. |
| | Feed | 0.030 in/rev. |

The following tools were tested:

N35/RD25 T1 NT27	N35/3 T1 NT31
N35/RD25 T2 NT28	N35/3 T2 NT32
N35/RD25 T3 NT29	N35/3 T3 NT33
N35/RD25 T4 NT30	N35/3 T4 NT34

and 0.030 in flankwear was taken as the criterion of tool life.

Test results

The wear of the tools was measured, as in figure 1, at intervals of three minutes cutting time and the results are shown on figures 2 - 13.

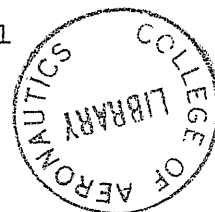
The growth of the flankwear for cutting condition (a) is shown graphically on figure 14. This figure shows that grade N35/3 gave the better performance. Although the wear pattern was similar for the two grades the nose of one of the N35/RD25 tools failed before the flankwear had reached 0.030 in. and the nose of the second tool tested was worn 0.004 in. at the end of its life whereas the N35/3 tools had no measurable nose wear.

Figure 15 shows the growth of the flankwear for test conditions (b). Most of the wear on both grades of tool was confined to a groove at the depth of cut, as shown by the photographs in figure 17. Under test conditions (b) both grades gave a similar tool life.

Figure 16 shows the growth of the flankwear for test condition (c) and again both grades gave a similar tool life. As can be seen from the photographs in figure 18 of the tools at the end of the test both grades exhibited cratering and deformation of the cutting edge.

Conclusions

At 500 fpm and 0.010 in/rev. feed grade N35/3 gave a better tool



life than grade N35/RD25, although at 250 fpm there was no significant difference between the performance of the two grades. At 250 fpm and 0.010 in/rev. feed both grades of tool had a groove at the depth of cut and at 250 fpm and 0.030 in/rev. feed both grades suffered cratering and severe deformation of the cutting edge.

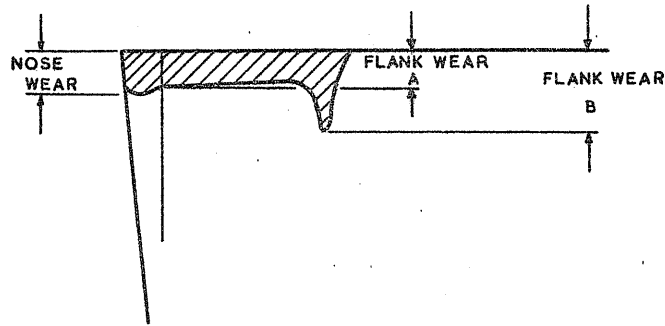


FIG. I. TOOL WEAR MEASUREMENT.

EXPERIMENTAL RECORD

EXPERIMENT: Tool N35/3 T1 NAME M.A. Wooding
 REMARKS: EN9, 500 fpm, .01"/rev. .10 depth DATE

TIME	NOSE	FLANK WEAR		Hardness	Remarks							
	WEAR	A	B									
1/2	.0015	.0015	.0015									
1	.0035	.0035	.0035									
2	.0045	.0045	.0045									
3	.0045	.0045	.0045									
5	.007	.007	.006									
7	.0085	.0085	.0075	205	Built Up Edge, Chip started to become discontin-							
9	.0095	.0095	.0075		" " " " " " " "							
12	.0095	.0095	.0105		" " " " " " " "							
15	.010	.010	.012		" " " " " " " "							
18	.012	.012	.0145		" " " " " " " "							
21	.015	.015	.0165									
24	.017	.017	.020									
27	.017	.017	.023									
30	.018	.018	.024									
33	.019	.019	.026									
36	.020	.020	.027									
39	.021	.021	.034									

FIG. 2.

EXPERIMENTAL RECORD

EXPERIMENT: Tool N35/RD 25 T2 NAME M.A. Wooding

REMARKS: EN9, 500 ft/min., .01"/rev., .10 depth DATE

TIME	NOSE	FLANK WEAR		Hardness	Remarks
	WEAR	A	B		
3	.006	.006	.006		
6	.008	.008	.009		
9	.0085	.0085	.010	213	
12	.009	.009	.013		
15	.0115	.0115	.018		
18	.016	.016	.022		
21	.0175	.0175	.025		
24	.019	.019	.0265		
27	.020	.020	.0285		
30	.024	.024	.032		Tool point worn .004
					FIG. 3.

EXPERIMENTAL RECORD

EXPERIMENT: Tool N35/RD 25 T1 NAME M.A. Wooding

REMARKS: EN9, 500 fpm, .01"/rev., .10 depth DATE

TIME	NOSE	FLANK WEAR		Hardness	Remarks
	WEAR	A	B		
3	.0055	.0055	.0055		
6	.008	.008	.009		
9	.009	.009	.012	213	
12	.011	.011	.0145		
15	.012	.012	.019		
18	.016	.016	.023		
21	.050	.030	.026		Nose failure
					FIG. 4.

EXPERIMENTAL RECORD

EXPERIMENT: Tool N35/3 T2

NAME M.A. Wooding

REMARKS: EN9, 500 fpm, .01"/rev., .10 depth

DATE _____

TIME	NOSE	FLANK WEAR		Hardness	Remarks
	WEAR	A	B		
1/2	.002	.002	.002		
1	.0035	.0035	.0035		
2	.0035	.0035	.0035		
3	.0045	.0045	.0045		
5	.006	.006	.006		Chip started to become discontinuous
7	.007	.007	.007		
9	.009	.009	.009	206	
12	.010	.010	.010		
15	.010	.010	.012		
18	.0105	.0105	.0155		
21	.012	.012	.016		
24	.013	.013	.020		
27	.016	.016	.023		
30	.016	.016	.024		
33	.017	.017	.026		
36	.019	.019	.031		
39	.019	.019	.033		
					FIG. 5.

EXPERIMENTAL RECORD

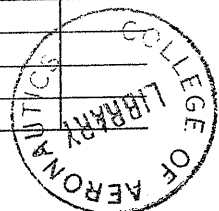
EXPERIMENT: Tool N35/RD25 T1 NT27

NAME M.A. Wooding

REMARKS: EN9, 250fpm, .030 in/rev., 0.10 in depth

DATE 28/9/63

TIME MIN	NOSE	FLANK WEAR		FLANK D/FORM ³ N	Hardness	Remarks
	WEAR	A	B			
3	.018	.0035	.0035	.0005		
6	.019	.004	.004	.0015		
9	.0205	.006	.005	.0015		
12	.022	.0065	.006	.0015	230	
15	.023	.007	.007	.0015		
18	.024	.009	.009	.0025		
24	.0265	.010	.010	.0025		
30	.028	.012	.013	.0025		
36	.030	.0155	.0165	.0035		
42	.0315	.020	.020	.004		
48	.036	.021	.021	.005	234	New Bar
54	.037	.021	.023	.005		
60	.038	.021	.0265	.005		
66	.038	.022	.0265	.005		
72	.041	.0255	.030	.006		
78	.0415	.026	.0305	.006		
84	.042	.0265	.034	.0065		
						FIG. 6.



EXPERIMENTAL RECORD

EXPERIMENT: Tool N35/RD25 NT28 NAME M.A. Wooding

REMARKS: EN9, 250fpm, .030in/rev., 0.1 in depth DATE 23/9/63

TIME	NOSE	FLANK WEAR	FLANK	Hardness	Remarks
MIN	WEAR	A B	D/MATION		
1	.003	- -	-		Discontinuous chip
2	.004	.001 .001	-		
6	.005	.0045 .0045	.0005		
9	.0085	.005 .005	.001		
12	.009	.006 .006	.001	247	
15	.011	.007 .007	.001		
18	.012	.008 .009	.0015		
24	.014	.0115 .013	.003		
30	.0175	.014 .0155	.003		
36	.0215	.017 .0175	.003		
42	.0215	.018 .0205	.003	218	Change bar
48	.022	.019 .0205	.005		
54	.024	.020 .0225	.005		
60	.0265	.022 .023	.006		
66	.029	.027 .025	.007		
72	.033	.0295 .029	.008		
75.5	.033	.030 .030	.008		
78	.048	.031 .030	.009		
					FIG. 7.

EXPERIMENTAL RECORD

EXPERIMENT: Tool N35/3 T1 NT31 NAME M.A. Wooding

REMARKS: EN9, 250fpm, .030 in/rev., .10 depth DATE 28/9/63

TIME	NOSE	FLANK WEAR	FLANK	Hardness	Remarks
MIN	WEAR	A B	D/MATION		
3	.0055	.0035 .0035	.0005		
6	.007	.0045 .0045	.0005		
9	.007	.005 .005	.0005	230	
12	.007	.0055 .005	.001		
15	.007	.006 .006	.001		
18	.0095	.0065 .007	.002		
24	.011	.0095 .010	.002		
30	.0125	.0095 .013	.002		
36	.015	.013 .014	.003		
42	.017	.017 .017	.003		
		Tool returned to P.T.A. for inspection			
					FIG. 8.

EXPERIMENTAL RECORD

EXPERIMENT: Tool N35/3 T2 NF32

NAME M.A. Wooding

REMARKS: EN9, 250fpm, .030 in/rev., .10 depth

DATE 23/9/63

TIME	NOSE	FLANK WEAR		FLANK	Hardness	Remarks
MIN	WEAR	A	B	D/MATTON		
1	.0 -	.00 -	-	-		Discontinuous chip
2	.003	.0015	.0015	-		
6	.004	.004	.004	-		
9	.007	.005	.005	.0005		
12	.007	.006	.006	.0005	242	
15	.008	.006	.007	.0010		
18	.0095	.0065	.009	.0010		
24	.011	.009	.0135	.002		
30	.013	.011	.0155	.0025		
36	.015	.013	.018	.003		
42	.017	.014	.019	.004	218	New Bar
48	.018	.015	.0225	.004		
54	.0195	.018	.0235	.0045		
60	.024	.020	.026	.005		
66	.025	.0235	.028	.005		
72	.031	.028	.030	.006		
78	.047	.035	.031	.009		New Bar
						FIG. 9.

EXPERIMENTAL RECORD

EXPERIMENT: Tool N35/RD25

NAME M.A. Wooding

REMARKS: EN9, 250fpm, .01 in/rev., 0.10 in depth

DATE 16/9/63

TIME	NOSE	FLANK WEAR		Hardness	Remarks
MIN	WEAR	A	B		
3	.0025	.0025	.0055		Built Up Edge
6	.003	.003	.0055		Built Up Edge
9	.0035	.0035	.007		Built Up Edge
12	.004	.004	.007	212	Cratering started
18	.004	.004	.010		No built up edge
24	.0045	.0045	.010		
30	.005	.0045	.011		
36	.005	.005	.0135		
42	.005	.005	.015		
48	.006	.005	.0185		
54	.006	.006	.021		
60	.006	.006	.023		
66	.006	.006	.025		
72	.006	.006	.027		
78	.006	.006	.029		
84	.007	.007	.032		
					FIG. 10.

EXPERIMENTAL RECORD

EXPERIMENT: Tool N35/3 T4 NAME M.A. Wooding

REMARKS: EN9, 250fpm, .01 in/rev., .1 in depth DATE

TIME	NOSE	FLANK	WEAR	Hardness	Remarks
	WEAR	A	B		
3	.003	.003	.003		Built up edge
6	.003	.003	.004		Built up edge
9	.0035	.0035	.0045		Built up edge
12	.0035	.0035	.0045		Built up edge
18	.004	.004	.0045		Built up edge
24	.0055	.0055	.005		Built up edge
30	.0055	.0055	.005	215	Built up edge
36	.006	.006	.009		Built up edge
42	.006	.006	.012		Built up edge
48	.0065	.0065	.013		Built up edge
54	.0065	.0065	.016		Built up edge
60	.0065	.0065	.019		
66	.007	.007	.020		
72	.007	.007	.022		
78	.008	.008	.023		
84	.008	.008	.024		
90	.008	.008	.0265		
96	.008	.008	.028		
102	.008	.008	.030		
108	.009	.009	.0315		

FIG. 11.

EXPERIMENTAL RECORD

EXPERIMENT: Tool N35/RD25 T4 NAME M.A. Wooding

REMARKS: EN9, 250fpm, .010 in/rev., .10 in. depth DATE 16/9/63

TIME	NOSE	FLANK	WEAR	Hardness	Remarks
	WEAR	A	B		
3	.003	.003	.003		Built up edge
6	.0035	.0035	.004		Built up edge
9	.0035	.0035	.0045		Built up edge
12	.0035	.0035	.0045	212	Start of cratering
18	.0035	.0035	.0045		No built up edge
24	.005	.005	.0055		
30	.005	.005	.0115		
36	.006	.006	.013		
42	.006	.006	.015		
48	.006	.006	.016		
54	.006	.006	.017		
60	.006	.006	.018		
66	.006	.006	.020		
72	.006	.006	.022		
78	.006	.006	.022		
84	.006	.006	.024		
90	.006	.006	.025		
96	.007	.007	.027		
102	.007	.007	.029		
108	.007	.007	.030		
114	.007	.007	.034		

FIG. 12.

EXPERIMENTAL RECORD

EXPERIMENT: Tool N35/3 T3

NAME M.A. Wooding

REMARKS: EN9, 250 fpm, .01 in. feed, .1 depth.

DATE _____

TIME	NOSE	FLANK WEAR		Hardness B.H.N.	Remarks
	WEAR	A	B		
3	.003	.003	.003		Built up edge
6	.003	.003	.003		Built up edge
9	.0035	.0035	.0035		Built up edge
12	.0035	.0035	.0035		Built up edge
18	.004	.004	.004		Built up edge
24	.0045	.0045	.005		Built up edge
30	.005	.005	.006	215	Built up edge
36	.0055	.0055	.007		Built up edge
42	.006	.0055	.0105		Built up edge
48	.006	.006	.013		Built up edge
54	.006	.006	.014		Built up edge
60	.006	.006	.016		
66	.006	.006	.0185		
72	.0065	.0065	.020		Built up edge
78	.0065	.0065	.022		Built up edge
84	.0065	.0065	.0225		Built up edge
90	.0065	.0065	.025		Built up edge
96	.0065	.0065	.026		Built up edge
102	.007	.0065	.0275		Built up edge
108	.007	.0065	.029		Built up edge
114	.009	.0065	.029		Built up edge
120	.009	.0065	.031		

FIG. 13.

EN9 500 fpm, 0.01 in/rev, 0.10 in depth

— N 35
--- N 35/RD 25

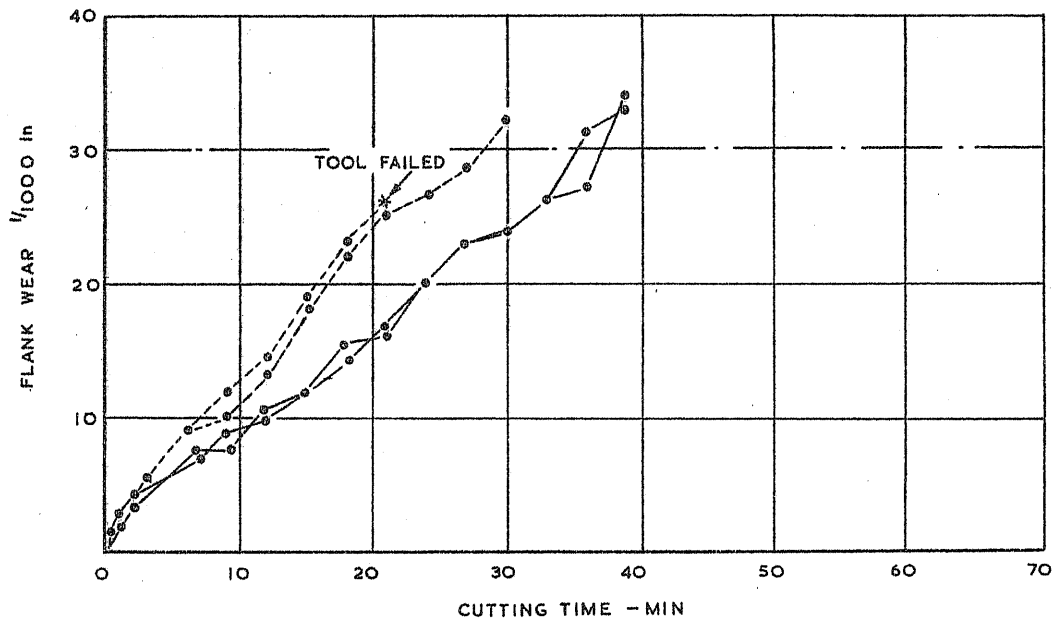
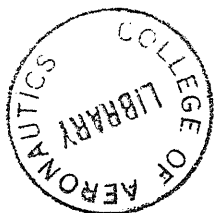


FIG. 14.



EN9 250 fpm, 0.010 in/rev, 0.10 in depth

— N 35/3
- - - N 35/RD 25

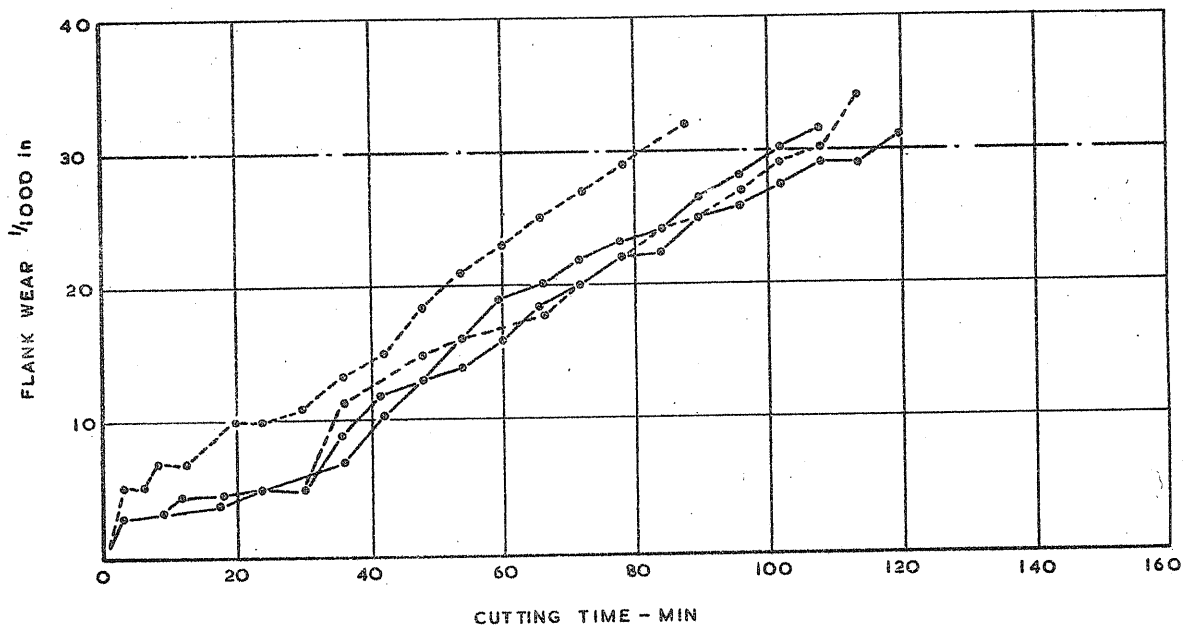


FIG. 15.

EN9 250 fpm, 0.030 in/rev, 0.10 in depth

— N 35/3
- - - N 35/RD 25

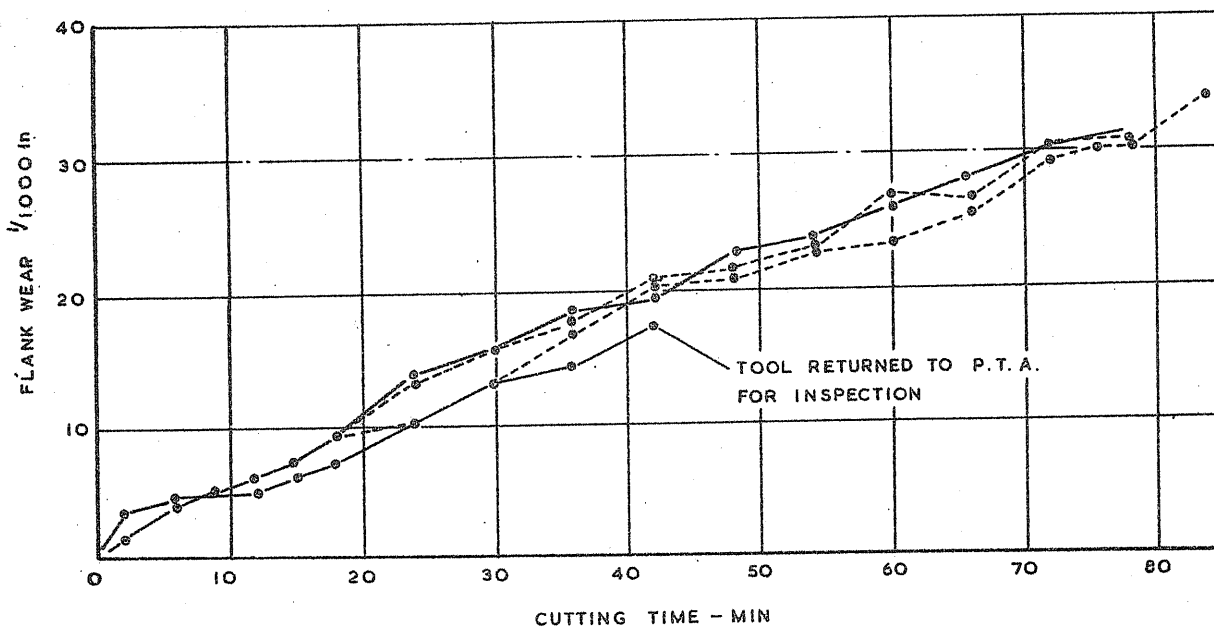
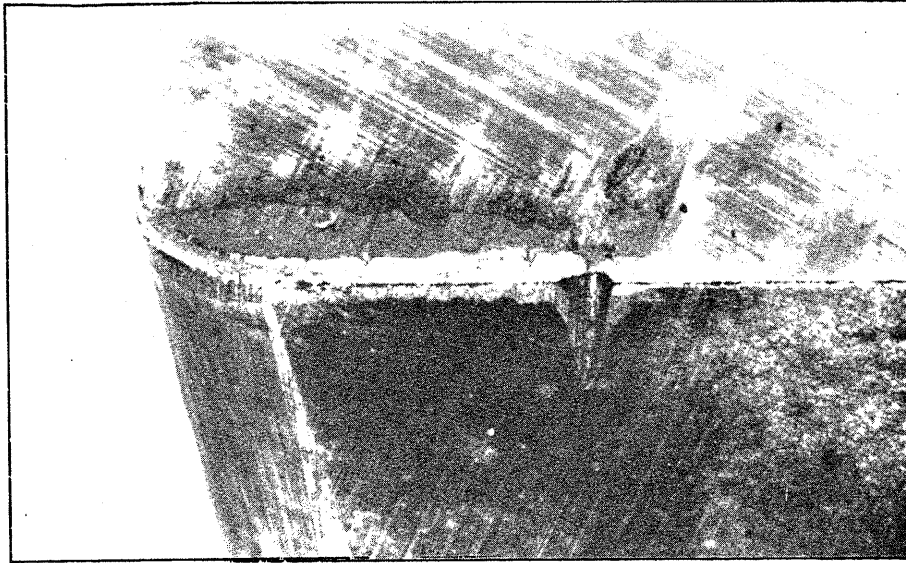
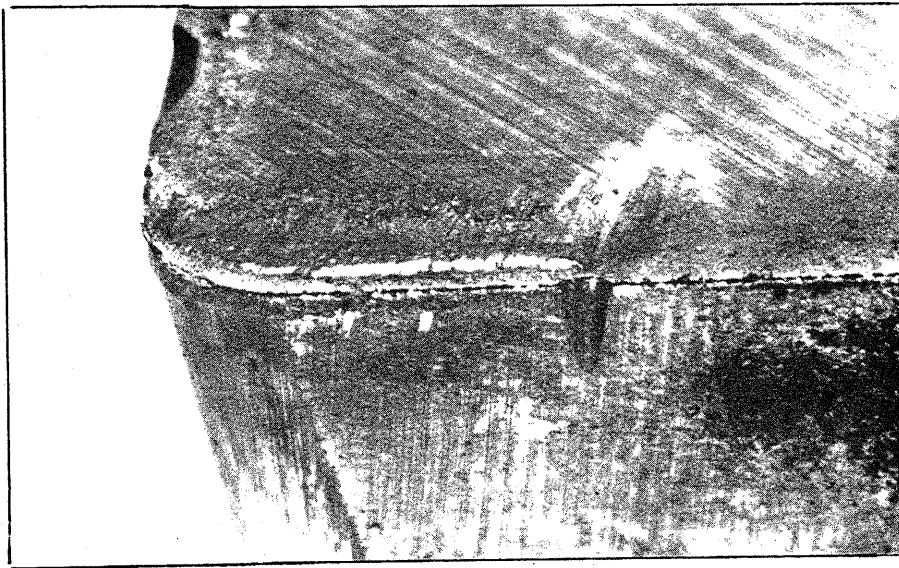


FIG. 16.



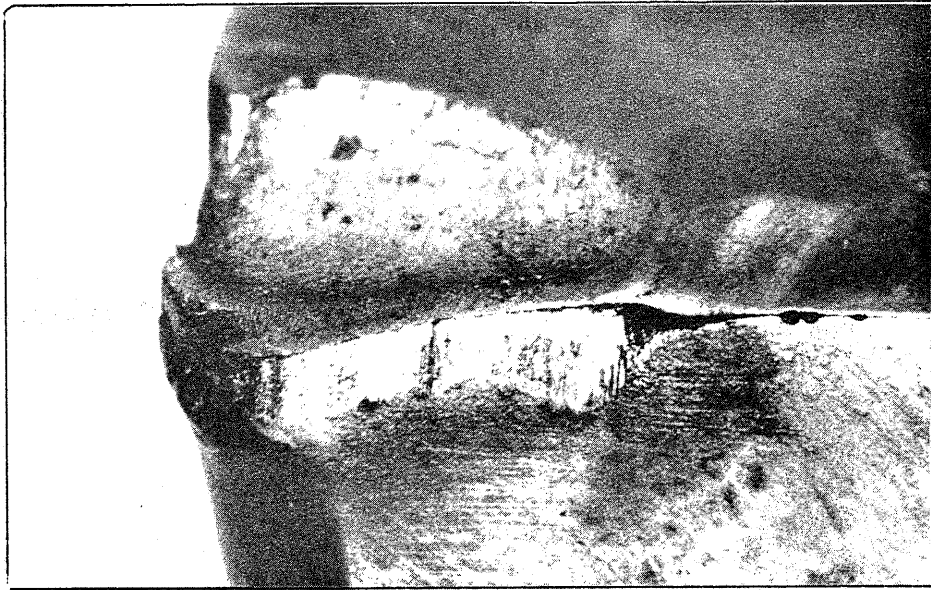
N 35/RD25 - T4 - NT30,
.030 in flank wear



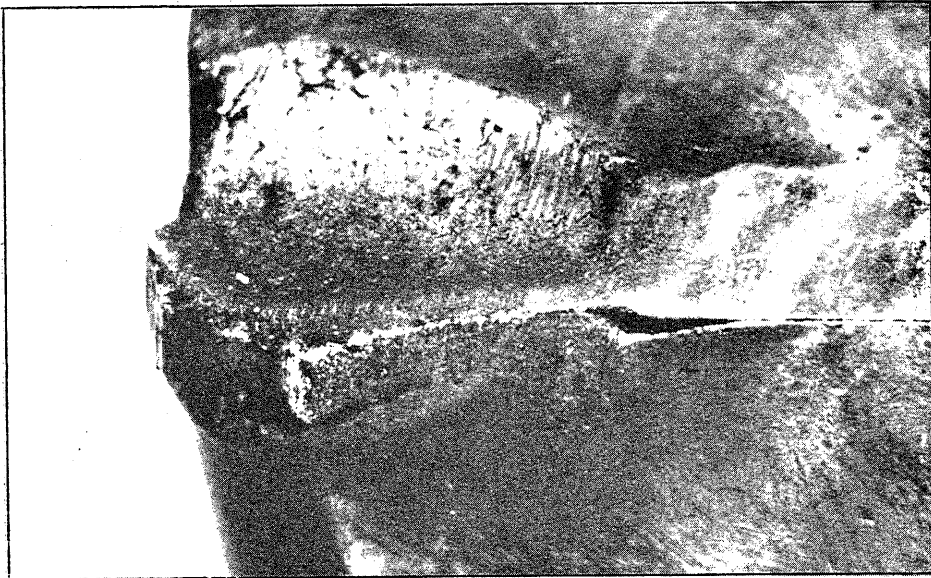
N 35/3 - T3 - NT33,
.030 in flank wear

FIG. 17 CUTTING CONDITIONS, 250 f.p.m.
.010 IN/REV FEED, .10 IN DEPTH OF CUT





N 35/RD25 - T2 - NT28,
.030 in flank wear



N 35/3 - T2 - NT32
.030 in flank wear

FIG. 18 CUTTING CONDITIONS, 250 f.p.m.
.030 IN/REV. .10 IN DEPTH OF CUT.