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APPROVED: Specific action by organizations or units will not be taken as a result of this report unless requested by HQ SAC under separate cover.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This is a study of the feasibility of restraining a parked alert aircraft with chocks which could be safely taxied over. Chocks were designed and then evaluated during SAC Giant Match II exercise. The chocks successfully restrained a parked aircraft and allowed a heavy weight aircraft to safely taxi over when the chocks were placed on a rough surface. Roll-over chock use was expanded command wide in 1980 for B-52G and KC-135 alert aircraft except on icy surfaces. Three ice gripping surface designs were evaluated in January 1981. All three designs performed successfully.		

1. **PURPOSE:** The purpose of this report is to document LGME's test results of a specially designed alert aircraft roll over chock.

2. **FOREWORD:**

a. Quick Start is an aircraft modification that allows simultaneous engine start on B-52G/H and non-fan C-135 aircraft. Use of the modification was suspended in 1974 due to a high concentration of toxic exhaust gas created by multiple cartridge firing. In 1977 LGME was tasked to study the feasibility of restraining a parked alert aircraft without having to remove chocks prior to taxi. The study concluded a small differently shaped chock will restrain the aircraft and also allow it to safely taxi over.

b. In 1978, LGME initiated a project, P-328, "Maintenance Posture for Quick Start" to consider alternate means of providing essential alert crew chief functions, while the crew chief remained clear of the toxic smoke cloud. Prototype roll over chocks were manufactured, and initial operational testing was accomplished under the authority of P-328. By March 1980, testing proved the roll over chocks should not be limited to only Quick Start operations. Consequently, LGME initiated this project to document continued development and testing separate from P-328.

c. The chocks were designed to allow an alert aircraft to safely taxi over them at 100°F ambient air temperature. Initial tests tried to duplicate, but were unsuccessful, the design criteria. In August 1978, the chocks were successfully tested with a KC-135A at Offutt AFB. Outside air temperature was 82°F. The chocks were then successfully tested with a B-52G at Mather AFB, September 1978. Outside air temperature was 83°F. Although ambient air temperature was lower than desired, these tests concluded that the chocks worked as designed. Increased thrust was required to taxi over the chocks, but the required thrust was less than normal rated thrust. Based on these results further testing was planned.

d. Additional taxi tests were accomplished at Wurtsmith AFB in February 1979, during HQ SAC directed exercise named Giant Match II. These tests concluded the chocks successfully restrained a parked aircraft. The chocks allow a heavy weight aircraft to safely taxi over when the chocks are placed on a rough surface, such as concrete. The chocks will not work on glare ice without an anti-skid surface applied between the chock and the ice. Finally, the chocks performed satisfactorily when exposed to jet engine blast. The final report recommended the chocks should be further tested in an operational environment but restricted from icy surfaces.

e. In the summer of 1979, selected aircraft units began using the roll over chocks on a daily basis. After a successful full year in an operational environment, roll over chock use was expanded command wide on B-52G and KC-135 alert aircraft. The chocks were still restricted from use on icy surfaces. They were also restricted from use on B-52H aircraft because the interphone connection placed the crew chief in close proximity to the left forward main landing gear. An interphone relocation modification proposal was approved by HQ SAC and sent to OC-ALC for final approval. Upon completion of the modification the chocks can safely be used on the "H" model. Use of the chocks on the B-52D was not seriously considered because the aircraft is not Quick Start modified.

3. CONCLUSIONS:

4. RECOMMENDATIONS:

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5. BACKGROUND:

a. Quick Start is an aircraft modification that allows simultaneous engine start on B-52G/H and non-fan C-135 aircraft. Full use of the modification was suspended in 1974 due to a high concentration of toxic exhaust gas created by the multiple cartridge firing. Investigations into a non-toxic cartridge starter and ground crew protective equipment were initiated. Initial results, however, indicated that neither devices were readily available. An alternate solution is to eliminate ground crew personnel from the immediate vicinity of the aircraft. This will minimize their exposure to the toxic smoke cloud.

b. In 1977, LGME was tasked to study the feasibility of restraining a parked alert aircraft without having to remove chocks prior to taxi. Results of the study, S-096, "Aircraft Parking Restraint for Quick Start" (Atch 1) concluded that use of a lower, differently shaped chock would successfully restrain an aircraft, and still allow it to safely taxi over the chock. The 55 Field Maintenance Squadron, Offutt AFB, manufactured a prototype set of the new roll over chocks. See Atch 2 for manufacturing instructions.

c. In 1978, LGME initiated a project, P-328, "Maintenance Posture for Quick Start" to re-evaluate alert crew chief duties for operating in the Quick Start toxic environment. An LGM working group was formed to recommend changes in ground crew procedures. One of their recommendations was to actively pursue further testing roll over chocks. Therefore, initial test and evaluations were performed under Project P-328.

d. The chock was designed to perform under worst case conditions. Outside ambient air temperature of 100°F was used to calculate available engine thrust. Aircraft maximum ground handling weight was used in calculating the chock's size. As shown in S-096 (Atch 1), thirteen degrees is the maximum slope of the chock that a B-52D/G and KC-135A can taxi over at 100°F. Although mother nature didn't want to cooperate, our initial tests of the chock tried to reflect these worse-case conditions.

e. The first test was conducted at Offutt AFB, 31 August 1978. A KC-135A was fueled to maximum ground handling weight. Outside ambient air temperature was 82°F. Aircraft engines were started using normal pneumatic starting procedures. Engine pressure ratio (EPR) is the only cockpit instrument used to calculate engine thrust. Therefore, engines were advanced from idle, in increments of 0.1 EPR settings, until the aircraft taxied. These readings were recorded and are shown in Table I, Atch 3.

f. Taxi tests #1 and 2 were accomplished with the chocks placed snugly against the number 5, 6, 7, and 8 tires. Brakes were released prior to advancing the throttles. Taxi test #3 was conducted with no chocks installed. This established baseline EPR readings to taxi the aircraft normally. As Table I shows an average increase in EPR of 0.9 was required to taxi over the chocks. This test concluded a fully loaded KC-135A will safely taxi over the chocks with an increased power setting. The increased power, however, is less than normal rated thrust.

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g. We then tested the chocks on a B-52G at Mather AFB, 14 Sep 78. The "G" model was selected for testing because it is a Quick Start modified aircraft and the "G" model has less available thrust at 100°F than the "H" model. Outside ambient air temperature during this test was 83°F. Computed normal rated thrust was 2.06. Five taxi tests were successfully accomplished. In each case, thrust required to taxi over the chocks was less than NRT, as shown in Table II, Atch 3. See attachment 4, for complete test results.

h. In Feb 79, HQ SAC directed a second evaluation of the Quick Start modification capabilities. The exercise was named Giant Match II and was conducted at Wurtsmith AFB. During the exercise, several taxi tests were accomplished to further evaluate the roll over chock's effectiveness. A B-52G and a KC-135A, both serviced to maximum ground handling weight, participated in the test.

i. To evaluate the restraining capability of the chocks, the B-52G started all engines, released brakes and advanced four engines to 90% RPM. Similarly, the KC-135A advanced two engines to 90% RPM. The chocks successfully restrained both aircraft. This test was repeated with the KC-135A defueled to the lightest gross weight any tanker has on alert. Again, the chocks successfully restrained the aircraft. To determine the effect of jet blast, the chocks were positioned approximately 200 feet behind the inboard pods of both aircraft. In both cases, the chocks stayed in place when all engines were advanced to 90% RPM. Above 90% RPM, the chocks were lifted and flipped end over end. The test concluded, however, the chocks performed satisfactorily when exposed to engine jet blast. It would be unusual for an aircraft to maintain 90% RPM or greater while taxiing.

j. The final test evaluated the chock's effectiveness on glare ice with the KC-135A. Because of the chocks low profile, the aircraft was restrained until the complete surface area of the tire was on the chock. At this point, the tires started to rotate backwards (as if trying to roll back down the chock) and pitched the chock forward into the front tires. The test concluded that a means to increase the friction between the chock and the ice was required before the chocks could be used in a winter time environment.

k. In the summer of 1979, selected aircraft units were directed to implement the new Quick Start procedures and equipment (tested during Giant Match II) on a daily basis. Each unit locally manufactured the required number of chocks and used them during non-icy conditions. After the chocks were used for a year in the operational environment, we concluded the advantages of using the roll over chocks were many. In 1980 the decision was made to expand use of the roll over chocks to all B-52G/H and KC-135A aircraft. In Mar 80, we separated further development and testing of the chocks from the original P-328 project, and initiated this project to document our efforts under separate cover.

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l. During our tests we noted B-52 crew chiefs generally use the interphone connection located in the left forward wheel well. This position allows ready access to the forward chocks. Being connected to the wheel well interphone box places the crew chief extremely close to the left forward main landing gear, with his back to the tire. This is an especially dangerous position to be with the aircraft ready to taxi. When using roll over chocks there is no need for the crew chief to enter the wheel well area, except to disconnect the interphone. Besides the forward wheel well the B-52G also has an interphone connection in the main external power receptacle, located on the forward right side of the fuselage. Therefore, B-52G crew chiefs are instructed to use the main external power receptacle interphone connection when roll over chocks are used.

m. The B-52H does not have an interphone connection in the external power receptacle. Instead, this connector is located in the "47" section (aft portion of aircraft). For this reason, the B-52H is restricted from using roll over chocks until the interphone connection can be relocated, LGME, with the help of the 410 AMS radio shop, Keesler AFB, prototyped, and kit proofed a relocation modification proposal. The proposal was approved by the HQ SAC Command Configuration Control Board on 12 Jun 81 (see Atch 5), and was sent to OC-ALC/MMH for final approval. Once the modification is complete, the B-52H will begin using roll over chocks.

n. Our investigation into designing an anti-skid surface for the chocks took two separate paths. We first looked into the feasibility of using rubber chocks. The idea was to insert studs (similar to studded snow tires) into the bottom of the chocks. Also, rubber chocks would flex if the ice surface was not flat. SA-ALC (prime depot for aircraft chocks) has performed several studies into different types of materials for making chocks. Generally, their investigations have concluded that wood is the most economical and suitable material for aircraft chocks (see Atch 6). Based on their experiences, they were reluctant to aid our investigation. Also, lack of research and development funds prevented us from pursuing our rubber roll over chock investigation any further.

o. Our second investigation was to design an anti skid surface that could be applied to the bottom of the chocks. After evaluating several ideas in the laboratory, we selected three for further testing. The first idea was to mix coarse walnut shells in sealing compound (MIL-S-8802) and apply the combination to the bottom of the chock. The second idea was to apply walkway compound, with grit (MIL-W-5044 Type II) to the bottom of the chock. For the third design, a three quarter inch angle iron frame was manufactured to fit the chock. Expanded metal was tack welded on the bottom, inside portion of the frame. The chock was placed inside and the assembly was held together with several small screws. See attachment 7 for specific construction details.

p. The anti-skid designs were tested at Griffiss AFB, 17 Jan 81. Three sets (two each) of roll over chocks were modified per the test plan. Taxi tests over the chocks were accomplished by a B-52G and a KC-135A, both serviced to maximum ground handling weight. Complete test procedures and results are contained in attachment 8. The tests concluded that all three anti skid designs successfully held the chocks in place on glare ice. Due to snow build-up and packing, the angle iron frame seems to be the optimum design. Before the chocks are used on icy surfaces, an operational test of the angle iron frame design should be performed during an entire winter season, at one unit. Also, prior to using the chocks on ice, aircrews must be aware of the difficulty of aircraft control on ice due to the increased power required to taxi over the chocks.

8 Atch

1. Engineering Report No. S-096
2. Alert Aircraft Roll Over Chocks, HQ SAC/LGM Ltr dtd 20 Jan 81
3. EPR Readings
4. Trip Report, 12-18 Sep 78
5. Class IVB Mod, "Relocation of B-52H Interphone Connection"
6. Valve Engr Project No. SAVE 6-102, Synthetic Rubber Aircraft Wheel Check
7. HQ SAC/LGME Test Plan P-328-T-2
8. Trip Report, 15-17 Jan 81

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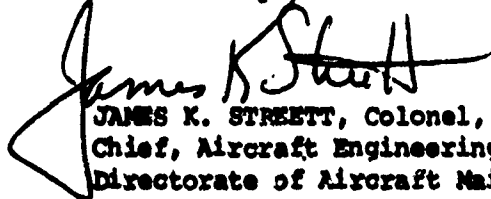
HEADQUARTERS STRATEGIC AIR COMMAND
DIRECTORATE OF AIRCRAFT MAINTENANCE
AIRCRAFT ENGINEERING DIVISION

ENGINEERING REPORT NO. S-096

AIRCRAFT PARKING RESTRAINT FOR QUICK START

22 May 1978

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FOR THE COMMANDER IN CHIEF



T. W. LONGSWORTH, Colonel, USAF
Director of Aircraft Maintenance
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ATCH 1

1. PURPOSE: This report presents the results of an engineering study that investigated methods to restrain parked aircraft during Posture 4 and 5 without a requirement for a ground crewman to pull chocks during a Quick Start launch.

2. FOREWORD:

a. The Quick Start modification to the B-52 and KC-135 put cartridge starters on all engines as opposed to the old configuration of two cartridge starters on the B-52 and one on the KC-135. The modification to the B-52G/H fleet was completed in May 1976 and the KC-135s were finished in October 1975. The intent of the modification was to reduce the alert force response time by reducing the engine start time. Quick Start was successful in meeting its goal, but the toxic gas hazard associated with firing eight or four cartridges simultaneously was underestimated and Quick Start use was curtailed.

b. The advantages of the Quick Start modification to B-52 and KC-135 aircraft can be better realized if procedures can be developed that permit the crew chief to remain clear of the toxic gas envelope generated by firing all cartridges simultaneously. Adoption of such procedures would negate the need to mask the crew chief or to develop a non-toxic cartridge.

c. Development of these procedures is a two-part problem. First, to assure the aircraft is safely restrained but can taxi without the crew chief being required to pull chocks. Second, to position the ground support equipment in a manner that eliminates the need to move it before taxi. LGME was tasked to recommend a solution to the first problem and LGMS would work the second part. If these problems can be solved, savings amounting to several million dollars per year could be realized.

d. Three alternatives were studied by LGME in solving the first problem--using the aircraft parking brake, using a different type of chock, or using parking restraints molded into the pavement. During the investigation, considerable help was received from the 93BMW, Castle AFB; Mr. E. Rustand, HQ SAC/DEMM; and Mr. L. Welliver, HQ SAC/LGMSB, Boeing Co. Technical Representative.

3. CONCLUSIONS:

a. The B-52 and KC-135 can be safely restrained during Posture 4 and 5 without requiring the crew chief to pull chocks for taxi.

b. Use of smaller, different shaped chocks which the aircraft can taxi over is the most feasible method (see Atch 2, Fig 5, for profile drawing).

4. RECOMMENDATIONS:

a. If ground support equipment can be relocated to preclude its movement before taxiing, then the recommended chocks be built and tested with an EWO loaded B-52G and KC-135.

b. Ground support equipment relocation and Quick Start ground crew launch procedures be developed as soon as possible.

5. DISCUSSION:

a. The full advantage of the Quick Start modification has not been realized because of the toxic gas hazard associated with simultaneously firing eight cartridges on the B-52 or four cartridges on the KC-135. Because of the toxic gas hazard, the crew chief or any late arriving crew member must be kept out of the gas envelope for at least 60 seconds after the cartridges are fired. This delay negates the time saved by starting all engines simultaneously.

b. Since no non-toxic starter cartridges are currently available, the possibility of equipping individuals with gas masks was explored by Hq SAC/DOOV after some preliminary gas mask tests by Hq SAC/LGMS. The results of the tests convinced both maintenance and operations personnel that gas masks were not an acceptable alternative. The gas masks were cumbersome to carry and work in and the manner in which the mask is donned is critical to the protection it provides. Finally, the mask makes interphone communication between the crew chief and flight crew difficult.

c. Before endorsing the requirement to develop a non-toxic cartridge, a second alternative was proposed by LGMS and LGME. The proposal was to develop procedures which would make it unnecessary for the crew chief to go near the aircraft after the cartridges were fired. The two main problems to this proposal were: (1) to keep the aircraft restrained on the parking stub without requiring chocks to be pulled before taxi, and (2) to keep the ground support equipment away from the aircraft so it would not be a taxi hazard. LGME agreed to study problem 1 and LGMS would work problem 2. The proposal also stated these procedures would only be used during advanced postures and the normal day-to-day procedures would remain unchanged.

d. Three different alternatives with regard to restraining aircraft during Posture 4 and 5 were studied. They were: (1) using the aircraft parking brake, (2) using smaller, different shaped chocks which could be taxied over, and (3) permanent bumps molded into the pavement on the alert aircraft parking locations. Each offers distinct advantages and disadvantages and will be discussed separately.

e. Parking Brake:

(1) The major advantage of using the aircraft parking brake is the ease and low cost with which the change could be implemented. No expense would be incurred since the aircraft would not be modified nor is additional ground support equipment necessary. The major disadvantage is that in the event the parking brake accumulator has an internal or external leakage problem, the parking brake is ineffective. This is true for both the KC-135 and B-52G/H even though the brake hydraulic circuits are different.

(2) The KC-135 parking brake uses the normal brake hydraulic circuit. The hydraulic pressure for the brakes can either be supplied by the left or right hydraulic system if the engines are running or by the auxiliary hydraulic pump (standby pump) if they are not. The brake accumulator can only be pressurized by the left system or the standby pump. After the brakes are applied, moving the parking brake lever mechanically holds the brake pedals down. The pressure in the brake accumulator then maintains the hydraulic pressure for the brakes. If the accumulator loses pressure through internal or external leakage, parking brake pressure is lost. However, the accumulator can be repressurized without running engines by running the standby pump with battery power. Unfortunately, continued use of the battery to run the standby pump quickly discharges it to an unacceptable level.

(3) The B-52G/H have identical brake systems and their operation closely parallels that of the KC-135. The differences are that the parking brake is only on the left forward gear and the standby pump for pressurizing the brake accumulator is hand operated as opposed to the electric standby pump on the tanker.

(4) To see how well the average aircraft brake accumulator holds pressure, LGME personnel checked nine tankers and nine bombers at Castle AFB during August 1977. The test sequence included pressurizing the brake accumulator, applying the brakes, setting the parking brake, and then repressurizing the brake accumulator to 3000 psi $\pm$ 50 psi for the bomber and to 3300 psi $\pm$ 200 psi on the tanker. The brake accumulator was then monitored and timed to see how long before the accumulator pressure bled down to 2100 psi or less.

(5) The results of the brake accumulator pressure checks (see Atch 1) were disappointing. Of the nine B-52G/H aircraft checked, only two held a pressure greater than 2100 psi for 45 minutes or more. The remaining seven bled down to less than 2100 psi in under 11 minutes. The KC-135 results were marginally better, five brake accumulators held for 45 minutes or more. Tabulated results are contained in attachment 1.

(6) If the pressure could not hold for at least 45 minutes, the drain on the battery to run the standby pump was considered unacceptable. Likewise, the need for a B-52 crew member or crew chief to hand pump the brake accumulator pressure up at intervals of less than 45 minutes was considered excessive. Consequently, the idea of using the parking brake alone to restrain aircraft for use with Quick Start was not acceptable unless the brake system pressure loss could be reduced significantly. This alternative was rejected because the improvements to the brake system could be quite costly and offset the potential major advantage of low or no cost stated initially.

f. Pavement Chocks:

(1) The second alternative investigated was building permanent humps into the pavement to act as chocks for the aircraft. The main

advantage is the ease with which an aircraft could taxi over the parking hump without the hazard of "pitching" a chock rearward that may be associated with taxiing over a normal chock. However, permanent humps have many disadvantages which outweigh its single advantage.

(2) The biggest disadvantage is the expense involved with building the permanent humps because the humps could not be "scab" patched to the existing surface. If they were "scab" patched, snow removal operations would soon scrape the humps loose. Scab patched paving material of any kind is also highly susceptible to cracking and chipping. Hq SAC/DEMM advised that the only acceptable method of building the humps would involve cutting into the existing pavement and anchoring the new paving material into the cavity. This would still not eliminate the snow removal obstruction, but it would reduce the probability of scraping the hump loose as well as reducing the cracking and chipping problem.

(3) If the humps are molded into the pavement, each time the alert parking plan changes the humps would have to be rebuilt. This problem would not be prevalent for alert pad parking because most bases have separate parking stubs for each type aircraft, but for split or non-optimum runway launches, many bases must park aircraft on taxiways during Posture 4 and 5. As the number of alert lines changes, the taxiway parking spots could not be adjusted to move the bombers or tankers to the best taxi position.

(4) Also, since the humps are permanently installed, the aircraft using them would have to be positioned precisely. It is unlikely this could be done by taxiing, so aircraft would have to be positioned with a tow vehicle for Posture 4 and 5 split or non-optimum runway launches.

(5) Because of these disadvantages, the use of permanent bumps molded into the pavement was rejected without calculating an exact cost of building all the permanent humps needed in SAC.

g. Modified Chocks:

(1) The final alternative investigated was the use of a smaller, different shaped chock which aircraft could taxi over. Low cost and crew chief familiarity with chock use are the advantages of this idea.

(2) A different shaped chock would be used exactly as a normal chock except it would only be used during Posture 4 and 5 during Quick Start operations. However, the manner in which the aircraft would be chocked would differ slightly. The new chocks could be procured at a relatively low cost when compared to the cost of installing permanent humps, but they would be more expensive than regular chocks.

(3) The two disadvantages causing the most concern are the tendency of the chock to be "pitched" rearward as the aircraft taxis over it and the increased strain on the aircraft landing gear caused by going over a chock.

(4) During this investigation, LGME talked to several eyewitnesses who have observed an aircraft taxi over a chock. In almost all cases, the chock was thrown backward and upward from under the aircraft gear with great force. This could cause aircraft damage and/or personnel injury. This action is caused by the shape of the chock which concentrates all the weight on the gear at one point with only friction to hold the chock in place. By changing the shape, this tendency to "pitch" the chock could be eliminated. The different shape would be a compromise that would not be quite as good as a normal chock in restraining the aircraft, but it would still be adequate to prevent unpowered aircraft motion. The change in chock shape would also reduce the strain on the aircraft landing gear when taxiing over the chock. A recommended size and shape chock and chocking instructions are included in Atch 2. Analysis and calculations to arrive at the optimum shape are included in the Atch 2 as well.

(5) Since the chock is a special item intended for occasional use, they may be lost or used improperly. All the problems of managing special items would be present in handling and controlling the use of the new chocks.

(6) One more problem associated with either the smaller, different shaped chock or pavement humps is the need for higher than normal engine power to get over the chock or hump. Higher power settings mean larger exhaust danger areas and greater possibilities of blowing foreign objects around the ramps and taxiways. This could be a serious problem when aircraft are parked nose to tail on a taxiway during Posture 4 and 5. Also, higher thrust requirements to begin aircraft movement will require more throttle finesse by pilots in order to operate the aircraft safely.

(7) Even with the disadvantages associated with smaller, different shaped chocks, they are the most viable alternative to having the crew chief manually pull the chocks. Several sets of chocks should be built and tested, but the cost is not justifiable until procedures to keep the ground support equipment away from the aircraft are developed.

DISTRIBUTION:

HQ SAC/LGM/LGME/LGMS/LGMM, Offutt AFB, NE 68113
OC-ALC/MMS/MMSG/MMSH, Tinker AFB, OK 73145

2 Atch

1. Brake Accumulator
Pressure Checks
2. Smaller Chock
Instructions

BRAKE ACCUMULATOR PRESSURE CHECKS

These tests were conducted at Castle AFB on 18 August 1977. The brake accumulator was pressurized and the parking brake applied and set. The brake accumulator was repressurized and timed until it leaked down to less than 2100 psi or 45 minutes, whichever came first.

Aircraft	T/N	Time	Pressure	Aircraft	T/N	Time	Pressure
B-52G	0168	1018	3000	KC-135	1488	1203	3400
		1023	2000			1210	3120
B-52G	0179	1008	3000			1217	2975
		1010	1500			1222	2880
B-52G	2582	0910	3000			1229	2750
		0920	2800			1239	2610
		0939	2500			1245	2475
		0945	2500			1251	2400
		0950	2400	KC-135	1500	1314	3350
		0955	2350			1323	3050
		1000	2300			1334	2860
B-52G	6511	1012	3000			1346	2700
		1016	2100			1354	2600
B-52G	6514	0815	3000			1358	2550
		0820	2800	KC-135	3550	1316	3400
		0825	2700			1324	2150
		0830	2650			1336	1700
		0835	2600	KC-135	3551	1106	3200
		0840	2550			1111	2975
		0845	2500			1116	2800
		0850	2500			1121	2550
		0855	2450			1126	2500
		0900	2400			1138	2300
B-52G		1022	3000			1145	2200
		1027	2000			1156	2050
B-52H	0012	0924	2950	KC-135	3559	1302	3400
		0937	1300			1308	2930
B-52H	0024	0926	3000			1318	2650
		0935	2200			1329	2450
		0940	1600			1340	2250
B-52H	1005	0934	3000			1350	2110
		0945	2100	KC-135	8014	1130	3100
KC-135	0009	1150	3500			1135	2600
		1200	2200			1146	2420
		1208	1950			1153	2300
KC-135	1313	1214	3400			1159	2220
		1224	2450			1208	2100
		1231	2300	KC-135	8034	1308	3200
		1236	2220			1319	2150
		1241	2200			1330	1970
		1250	2150				
		1256	2100				

SMALLER CHOCKS

1. In order to taxi over a chock and not overstress the gear or the aircraft, only the aft most wheels should be chocked. If the tanker is chocked this way, only four tires of the main gear would experience the bump and only one end of the main gear truck will flex up and down (see Fig 1). If it were chocked in the normal manner, two bumps would be experienced as each set of wheels went over the chock. When chocking the B-52, only the aft gear should be chocked for the same reasons. The B-52 and KC-135 are designed to go over a 4" bump without sustaining any damage so taxiing over these chocks should not present a problem.

2. The shape of the chock is extremely important. It must be tall enough to adequately restrain the aircraft but short enough to taxi over, and it must have a shape which will eliminate the tendency for it to be thrown rearward as the aircraft goes over it.

3. In the calculations to determine the ideal shaped chock, LGME took a conservative approach throughout the analysis. A worst case of 100°F outside air temperature was used to calculate available thrust and maximum ground handling weight was used wherever aircraft weight was needed for calculating chock size. However, the effect of tire deformation as the aircraft rolls over the chock was not included in the calculations.

4. The height of the chock can be quite low, since the chock only offsets the slope of the ramp and engine thrust at idle. To determine how well an aircraft can climb over a chock, the aircraft weight supported by the chocked wheels was calculated and compared to the available engine thrust. Available engine thrust was defined as engine thrust up to NRT power. Table 1 shows available thrust at 0°F and 100°F for the B-52D/G/H and KC-135A. Thrust can be considered a linear function for determining thrust at intermediate temperatures. Table 1 also shows gross weight and weight on the chocked wheels. For the B-52, a 45/55 weight distribution was used to determine weight supported by the aft gear. The weight supported by the four aft tires of the MLG on the tanker was determined by using Fig 2 which was obtained from the Boeing Co. We assumed a maximum aircraft weight of 296,000 and a center of gravity at 24% MAC.

5. The force required to roll a weight up a slope is given by:

$$F = \text{Weight} (\sin \theta)$$

Where θ is the angle of the slope (see Fig 3). Given the available thrust (force) and the weight on the chocked wheels, we can calculate $\sin \theta$.

$$\sin \theta = \frac{\text{Thrust}}{\text{Weight}}$$

Converting $\sin \theta$ to degrees gives the angle an aircraft can taxi up and over. Table 2 shows the chock angle the B-52 and KC-135 can taxi over at 0°F and 100°F.

6. To eliminate the tendency for the chock to be "pitched" backward when the aircraft goes over it, the friction force between the chock and the pavement must always be greater than the aircraft weight component tending to push the chock backwards. Referring to Fig 4, the weight on the chocked wheel can be broken into two components, Force A which is perpendicular to the face of the chock and Force B parallel to the face of the chock. Force A can then be broken into two components, Force N which is perpendicular to the ground and Force C parallel to the ground. Force C is the force tending to "pitch" the chock backwards. The friction Force F is given by the formula:

$$F = \mu N$$

Where μ is the coefficient of friction between the wooden chock and the pavement and N is the force normal to the ground. To prove Fmax (friction force) is always greater than Force C or:

$$\frac{F_{\max}}{C} > 1$$

Calculate tangent θ from the force vectors in Fig 4.

$$\text{Tangent } \theta = \frac{C}{N}$$

Solving for N:

$$N = \frac{C}{\tan \theta}$$

Substituting back into the friction equation:

$$F = \frac{\mu C}{\tan \theta}$$

$$\frac{F}{C} = \frac{\mu}{\tan \theta}$$

Using $\mu = .38$ as the coefficient of friction for wood to pavement and a $\theta = 13^\circ$, tangent $13^\circ = .23$.

$$\frac{F}{C} = \frac{.38}{.23} \text{ which is greater than } 1$$

The chock will not be "pitched" backwards. Thirteen degrees was used because 13° is the maximum slope chock the B-52D/G and KC-135A can go over at 100°F (worst case for available thrust).

7. Considering all factors, the recommended shape chock is shown and compared with a normal chock in Fig 5. This chock or any other chock still is susceptible to being blown backwards with jet blast, but since the chocks would only be used during Posture 4 and 5, they could be tied

to the alert vehicle. The primary concern was to be able to taxi over them without damaging the gear or the aircraft.

TABLE 1				
Aircraft	Gross Wt lbs	Wt on Chocked Wheels	Available at 0°F	Thrust at 100°F
B-52H	490,000	269,500*	134,720 ¹	105,200 ¹
B-52G	490,000	269,500*	100,000 ²	62,200 ²
B-52D	453,000	249,150*	93,800 ³	56,480 ³
KC-135A	296,000	136,000**	48,800 ⁴	31,800 ⁴

*45/55 weight distribution obtained from Boeing Co. through Lyman Welliver, Boeing Technical Representative.

**Calculated using graph in Fig 2 obtained from Boeing Co. assuming 296,000 gross weight and 24% MAC center of gravity.

¹Calculated using 1B-52H-1, Fig 1-3, and 1B-52H-1-1, Fig A3-31A.

16,840 lbs thrust each engine at 0°F
13,150 lbs thrust each engine at 100°F

²Calculated using 1B-52G-1-1, Fig A4-36, and Pratt & Whitney Curve 319270.

12,500 lbs thrust each engine at 0°F
7,775 lbs thrust each engine at 100°F

³Calculated using 1B-52B-1-2, Fig B4-39, and Pratt & Whitney Curve 319269.

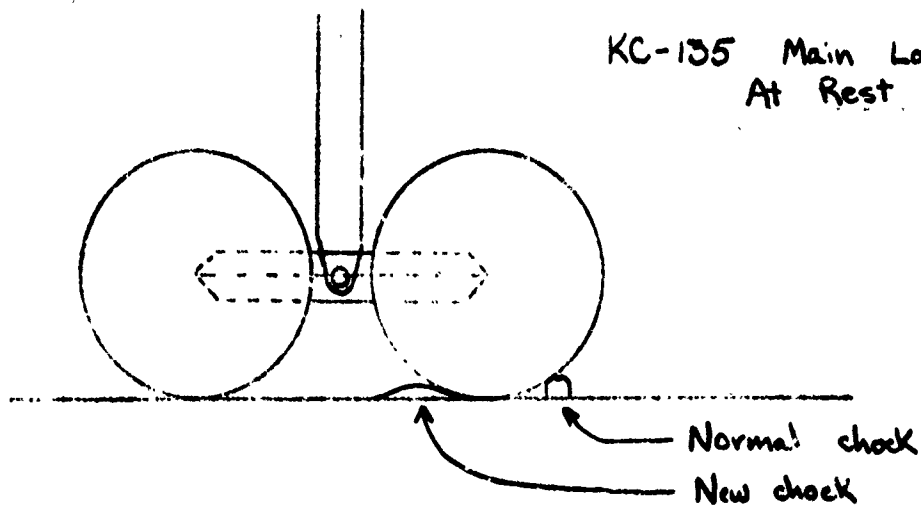
11,725 lbs thrust each engine at 0°F
7,060 lbs thrust each engine at 100°F

⁴Calculated using 1C-135(K)A-1-1, Fig 1A4-32, and Pratt & Whitney Curve 319270.

12,200 lbs thrust each engine at 0°F
7,950 lbs thrust each engine at 100°F

TABLE 2				
Aircraft	Sine θ		Max Slope of Chock (θ)	
	at 0°F	at 100°F	at 0°F	at 100°F
B-52H	.49989	.39035	30°	23°
B-52G	.37106	.23080	22°	13°
B-52D	.37648	.22669	22°	13°
KC-135	.35882	.23382	21°	13°

KC-135 Main Landing Gear
At Rest



KC-135 Main Landing Gear
Taxiing

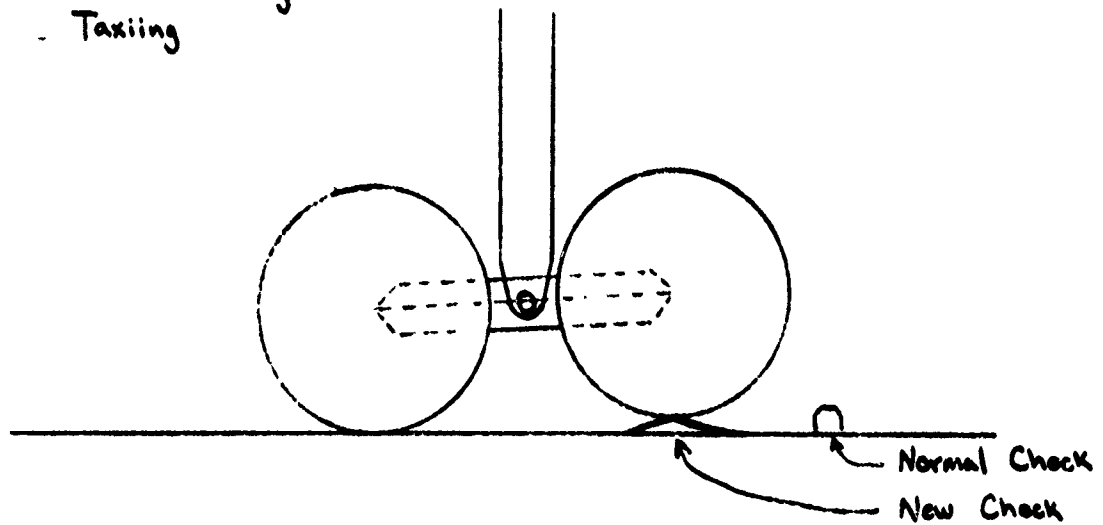
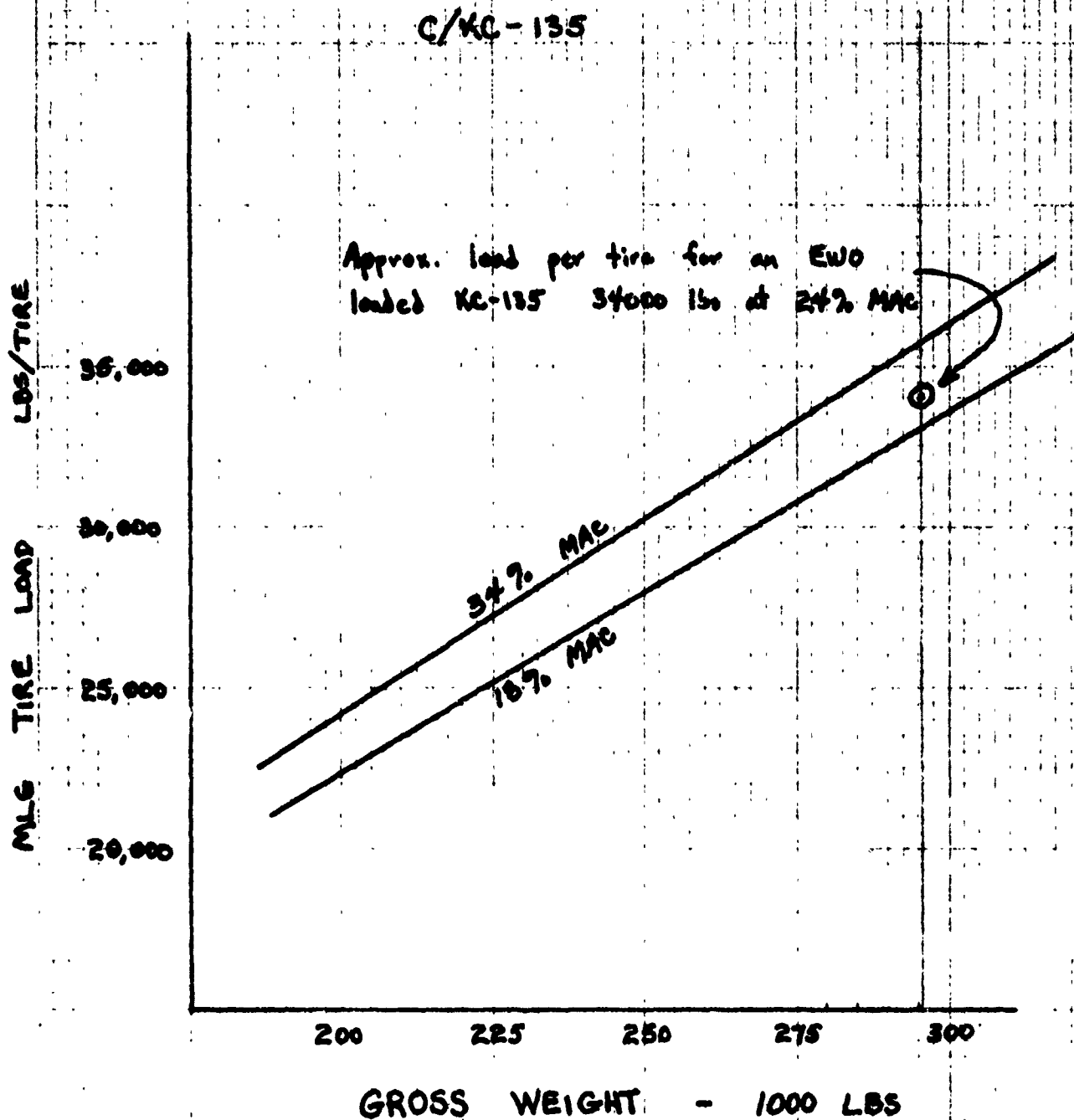


Fig 1



Source of graph - internal Boeing document
dated 21 May 1965

Fig 2

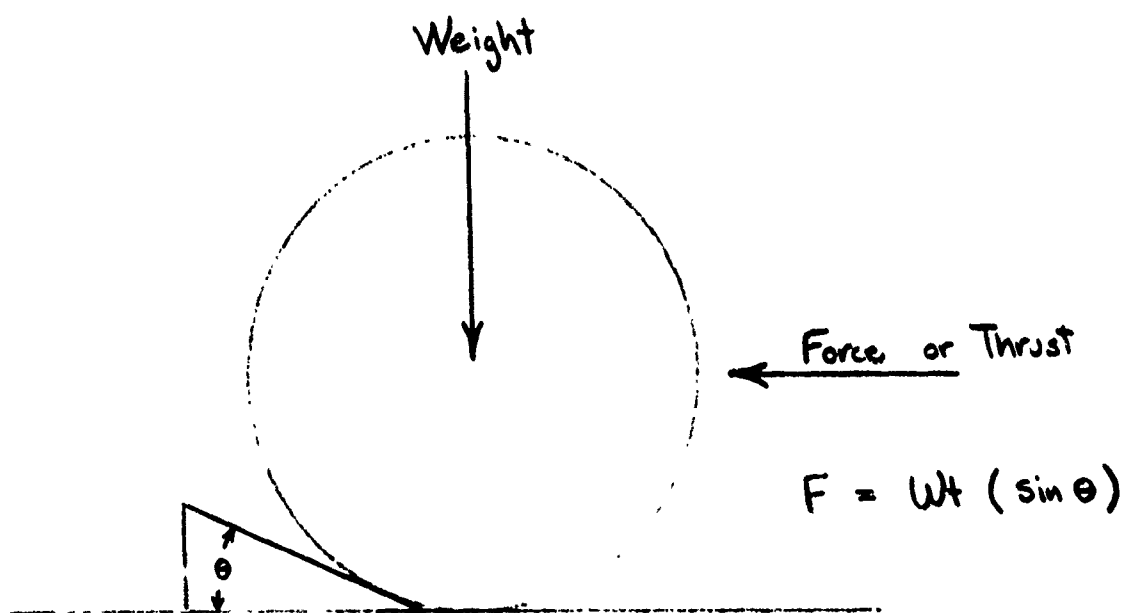


Fig 3

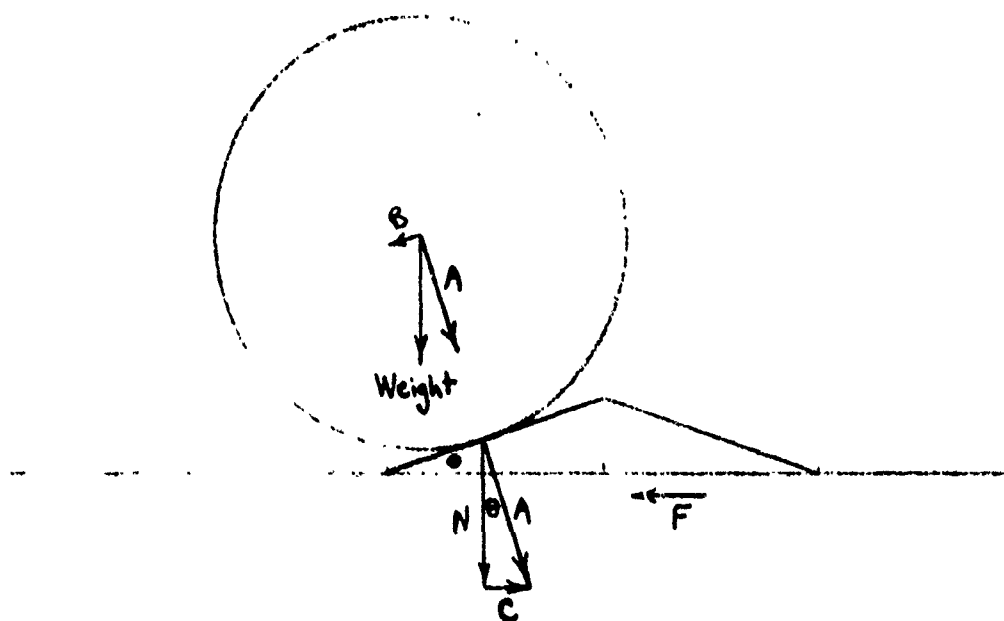


Fig 4

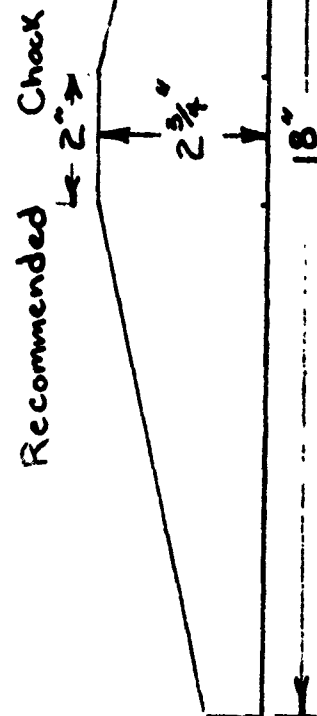
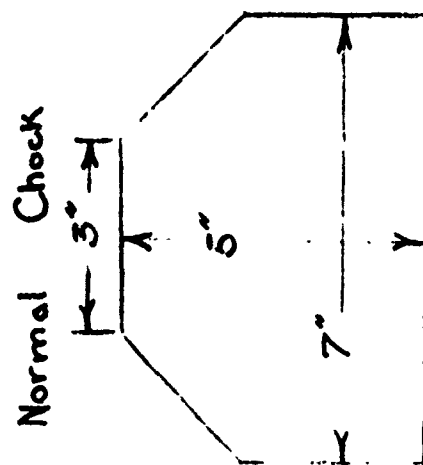


Fig. 5

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS STRATEGIC AIR COMMAND
OFFUTT AIR FORCE BASE, NEBRASKA, 68113



REPLY TO
ATTN OF: LGM

20 JAN 1981

SUBJECT: Alert Aircraft Roll-Over Chocks

TO: See Distribution List

1. Use of roll-over chocks is being expanded to all alert B-52G/H and KC-135 aircraft. Implementation orders and dates will follow under separate message. Locally manufacture, as a minimum, one pair of chocks per alert aircraft using the attached instructions. Also attached is a DD Form 1348-6 with a command assigned stock number for local manufacture.
2. There are three important items to be aware of when using roll-over chocks. First, the chocks are restricted from use on ice and snow covered ramps. During your entire time period for winter operation (where applicable), standard aircraft chocks should be used. Second, the chocks must be placed snugly against the number 5, 6, 7 and 8 tires. A gap between the tires and the chock could allow the aircraft to gain enough momentum to inadvertently roll-over the chock. Standard aircraft chocks will be used aft of these tires. Third, the chocks may shrink or expand due to environmental conditions. The nuts on the ends of the chocks must be inspected for tightness periodically.
3. On B-52G aircraft, the alert crew chief will use the interphone connection located in the main external power receptacle, instead of the connection located in the left forward wheel well. This is to remove the crew chief from directly in front of the left forward gear, and will protect him from injury in the event the aircraft taxis early. We are seeking modification approval to install an interphone connection in the external power receptacle on the B-52H. Until the aircraft are modified, the chocks will be restricted from use on the H model. Use of the chocks on the B-52D is not planned at the present time.
4. If you have any question concerning the manufacturing instructions contact Capt Connolly, LGME, AV 271-3750. For any other questions contact Capt Nunemaker, LGMST, X-5401 or SMSgt Shelley, LGMSB, X-5001.

Albert G. Petranick
ALBERT G. PETRANICK, Colonel, USAF
Director of Aircraft Maintenance
DCS/Logistics

Peace is our Profession

ATCH 2

DISTRIBUTION LIST

2 - 19BWM/MA/MAO, Robins AFB GA 31098
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2 - 340AREFG/MA/MAO, Altus AFB OK 73521
2 - 384AREFW/MA/MAO, McConnell AFB KS 67221
2 - 7BMW/MA/MAO, Carswell AFB TX 76127
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2 - 96BMW/MA/MAO, Dyess AFB TX 79607
2 - 319BMW/MA/MAO, Grand Forks AFB ND 58201
2 - 5BMW/MA/MAO, Minot AFB ND 58701
2 - 97BMW/MA/MAO, Blytheville AFB AR 72315
2 - 379BMW/MA/MAO, Wurtsmith AFB MI 48753

INFO:

7 - HQ SAC/IGF/CG/CK/LGMS/LGMM/LGMT/LGSE/IGOM
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1 - 12AD/LG Dyess AFB TX 79607
1 - 14AD/LG Beale AFB CA 95903
1 - 42AD/LG Blytheville AFB AR 72315
1 - 45AD/LG Pease AFB NH 03801
1 - 43SW/MA APO San Francisco 96334
1 - 55SRW/MA Offutt AFB NE 68113
1 - NGB/LGM, Wash DC 20310
1 - 4AD/LG FE Warren AFB WY 82001
1 - 19AF/LG Carswell AFB TX 76127
1 - 40AD/LG Wurtsmith AFB MI 48753
1 - 47AD/LG Fairchild AFB WA 99011
1 - 57AD/LG Minot AFB ND 58701
1 - HQAFRES/LGM, Robins AFB GA 31098

2 - 68BMW/MA/MAO, Seymour-Johnson AFB NC 27531
2 - 92BMW/MA/MAO, Fairchild AFB WA 99011
2 - 380BMW/MA/MAO, Plattsburgh AFB NY 12903
2 - 416BMW/MA/MAO, Griffiss AFB NY 13440
2 - 509BMW/MA/MAO, Pease AFB NH 03801
2 - 22BMW/MA/MAO, March AFB CA 92508
2 - 93BMW/MA/MAO, Castle AFB CA 95342
2 - 42BMW/MA/MAO, Loring AFB ME 04750
2 - 320BMW/MA/MAO, Mather AFB CA 95655
2 - 307AREFG/MA/MAO, Travis AFB CA 94535

ALERT ROLL-OVER CHOCK MANUFACTURING INSTRUCTIONS

1. The chocks will be constructed using number 1 common fir 2" x 4" lumber. Number 1 common lumber is essential to minimize splintering and knot dislodgement reducing the possibility of foreign object damage (FOD).
2. The chock will be assembled using 2" x 4"s, cut to the dimensions in Figure A of Atch 1, and laminated together. Total completed length should be 60" $+0$
 -2 ".
3. It is recommended that a template be used to ensure each 18" segment is cut to the exact dimensions given. The template should also be used to accurately locate the three bolt holes in each segment.

NOTE

Correct sizing, and hole location are essential for chock strength and integrity. Surface irregularities will cause stress concentrations under load which could cause splintering or complete failure.

4. After cutting the segment, the sides should be planed parallel to each other and perpendicular to the base. This process is necessary to remove board warpage and surface irregularities. This will also ensure maximum surface contact when the boards are laminated together. Minimum thickness of the segment should not be smaller than 1 1/4" after planing.
5. Drill the bolt holes to 9/16" I.D. This will allow a tight, close tolerance fit for the 1/2" O.D. steel rods. The middle rod centerline should be located 9" from the end and 1 1/2" up from the base. The center line of the outside rods should be located 5" from the ends and 1" up from the base (see Figure A).
6. Cut two end plates from 1/8" thick steel. The plate should be cut in the same profile as the segment; however, overall dimensions will be smaller. Maximum dimensions are length, 17 1/2"; end height, 1/2"; center height, 2 1/4". Locate as shown in Figure B.
7. The 1/2" O.D steel rods should be 62 1/2" long. Thread both ends (either 1/2" - 13 or 1/2" - 20) to a length of 2 1/2".
8. Insert the steel rods into the segment holes and laminate the segments using a strong wood glue. Install the steel end plates. Overall completed length will be 60" $+0$
 -2 ".
9. Prior to tightening the nuts, place the chock on a flat surface and align segments, as necessary, to ensure a smooth tapered surface. Tighten the nuts evenly to compress the laminated segments.

Atch 1

10. Attach an eyebolt to one end of the chock to facilitate a 3/4" O.D. rope.

11. Paint the chock AGE yellow (#13538).

12. Stencil in black on the 2" flat of the chock "FOR COCKED ALERT AIRCRAFT ONLY". Letters should be a minimum of 1" high.

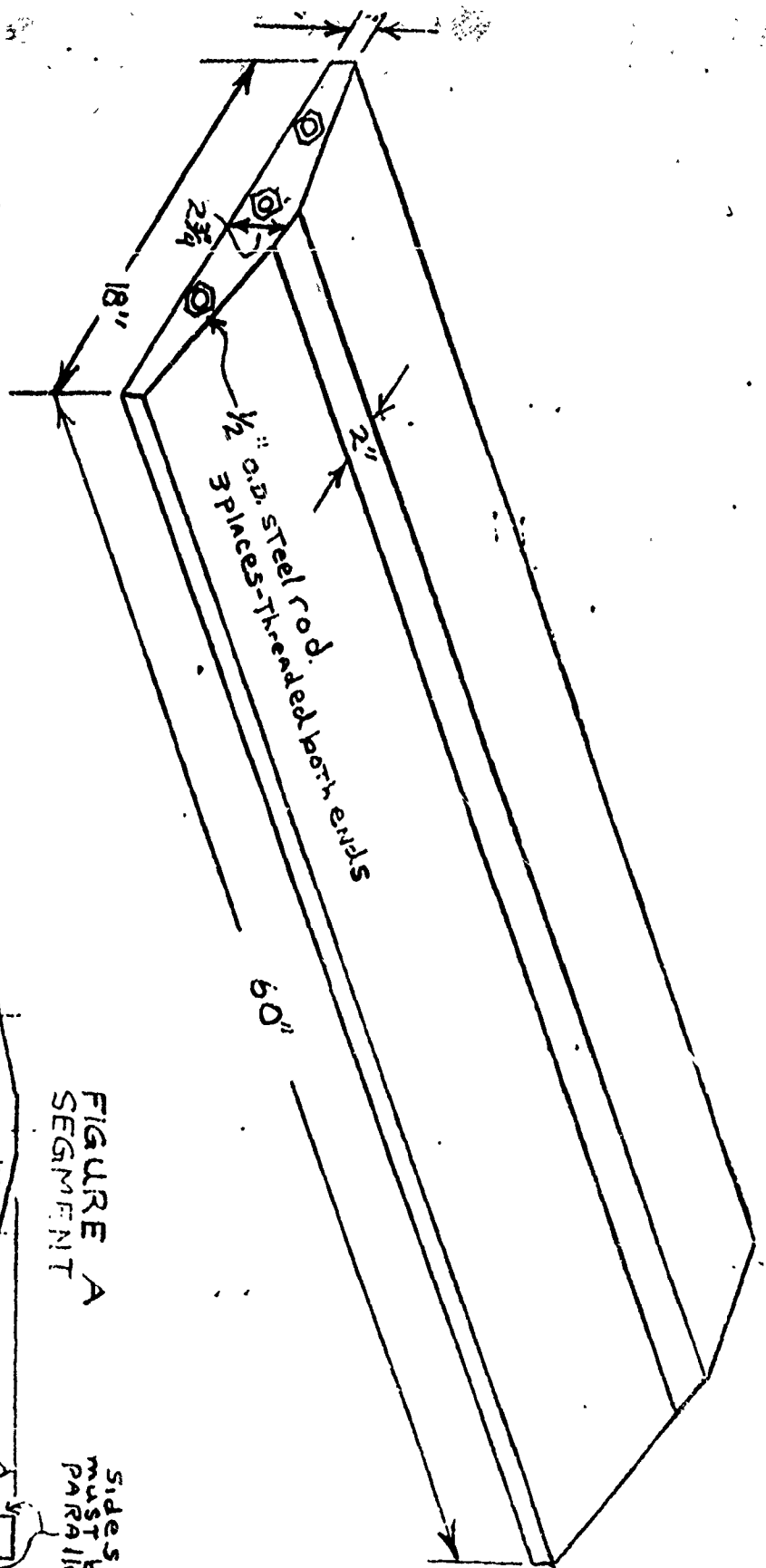


Figure A
ATTCH. 1

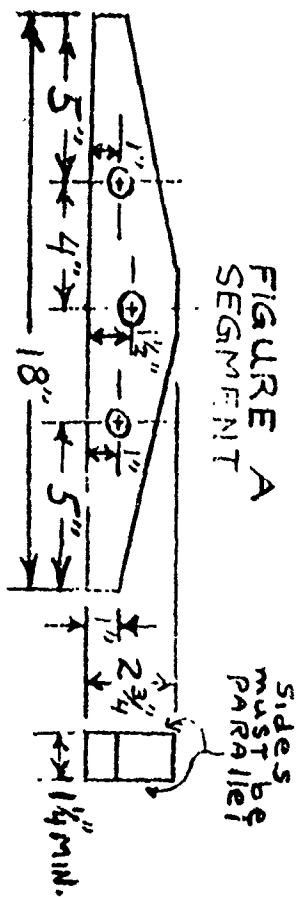


FIGURE A
SEGMENT

FIGURE B
END PLATE PLACEMENT



U.S. GOVERNMENT PRINTING OFFICE: 1977-238-141

DOCUMENT IDENTIFIER			ROUTING IDENTIFIER			M & S	MANUFACTURER'S CODE * AND PART NUMBER																UNIT OF ISSUE	QUANTITY				DOCUMENT NUMBER																				
							FSCM				PART NUMBER																	REQUISITIONER				DATE				SERIAL												
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IDENTIFICATION DATA	
1. MANUFACTURER'S CODE & PART NO. (When they exceed Card Columns 8 thru 22)	2. MANUFACTURER'S NAME LOCAL MANUFACTURE
3. MANUFACTURER'S CATALOG IDENTIFICATION AND DATE SEE ATTACHED ALERT ROLL-OVER CHOCK MANUFACTURING INSTRUCTIONS.	
4. TECHNICAL ORDER NUMBER	
5. TECHNICAL MANUAL NUMBER	6. NAME OF ITEM REQUESTED CHOCK, ALERT ROLL-OVER
7. DESCRIPTION OF ITEM REQUESTED SEE ATTACHED DRAWING AND ALERT ROLL-OVER CHOCK MANUFACTURING INSTRUCTIONS.	
7a. COLOR YELLOW	
7b. SIZE 60"L X 18"W X 2 3/4"	
8. END ITEM APPLICATION AND SOURCE OF SUPPLY ALERT AIRCRAFT	
8a. MAKE	8b. MODEL NUMBER
8c. SERIES	8d. SERIAL NUMBER
9. REQUISITIONER (Clear Text Name and Address)	
10. REMARKS ESTIMATED UNIT COST: \$50. (PR=\$100.) ERRC: XB3 RID: JBD B/C: 9	

FORM 1348-6
1 APR 77

(REVISED)

NON-NSN REQUISITION (MANUAL)

ATCH 2

B-4

	#1	#2	#3	#4
TEST 1	2.25	2.10	2.10	2.20
TEST 2	2.35	2.15	2.15	2.20
TEST 3	1.13	1.25	1.25	1.23

KC-135A FINAL EPR READINGS
 AMBIENT AIR TEMP 82 DEG F.

TABLE I

	#1	#2	#3	#4	#5	#6	#7	#8
TEST 1	1.90	1.80	1.80	1.90	1.90	1.90	1.70	1.80
TEST 2	2.00	1.90	2.00	2.00	2.00	1.95	1.95	1.80
TEST 3	1.90	1.80	1.80	1.80	2.00	1.95	1.95	1.80
TEST 4	2.10	2.00	2.00	1.90	2.05	1.98	1.95	1.90
TEST 5	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
TEST 6	1.10	1.20	1.20	1.10	1.20	1.10	1.10	1.10

B-52G FINAL EPR READINGS
 AMBIENT AIR TEMP 83 DEG F.

TABLE II

Visit to 320BMW, Mather AFB CA

1. The temperature at the beginning of the test was 83° F and 84° F at the conclusion. Computed NRT was 2.06 (approximately 92% RPM) and military rated thrust was 2.31 (approximately 96% RPM). In tests one and two, the chocks were placed tight against the aircraft tires. In tests three, four and five the chocks were positioned about three inches forward of the tires. In tests 1 thru 4 the brakes were released prior to advancing the throttles. Test 1, the throttles were advanced in distinct increments of 0.1 EPR until the aircraft taxied over the chocks. Average EPR reading was 1.8. Test 2, the flight crew advanced the throttles rapidly, simulating an alert response. Average EPR reading was 1.95. Test 3, selecting a target EPR reading of NRT, the throttles were advanced normally. Average EPR reading was 1.875 which was significantly less than the selected target reading. Test 4, the crew again advanced the throttles rapidly simulating an alert response. Average EPR reading was 1.985.

2. In tests 3 and 4, with the engines at idle, the aircraft rolled against the chocks and was restrained before the throttles were advanced. As a result these tests nearly repeated the conditions of tests 1 and 2. In test 5, the crew was asked to hold the brakes until engine acceleration stabilized. This occurred at an EPR reading of 1.75 on all engines. When the brakes were released, the aircraft effortlessly taxied over the chocks. All taxi tests were recorded on video tape.

3. During my stay at Mather AFB, I had the opportunity to discuss aircraft related problem areas with various maintenance managers throughout the DCM complex. One significant area of concern is the manhours consumed in the repair of B-52 lower bomb bay door assemblies. Low level sorties currently being flown are causing the doors to flex severely. This flexing is causing the ribs to crack, rivets to loosen, and the aircraft skin to tear. A program was initiated in June 1978 to completely rebuild the bomb bay doors as the B-52s cycle through PDM. Complete retrofit of the fleet is scheduled for the 1980-82 time frame. SMSgt Kolenski (OMS Bomber Branch, NCOIC) has submitted a low cost suggestion to reinforce the bomb bay door structure. The suggestion was evaluated and disapproved by the sheet metal shop at unit level. Lt Col Harrison (ADCM) and myself strongly feel that the suggestion should be resubmitted for off base evaluation. Adoption of the suggestion could provide a cheaper, faster, and easier solution to the problem, which could be as effective as the complete PDM rework program.

12-2

17-41

B-7

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS STRATEGIC AIR COMMAND
OFFUTT AIR FORCE BASE, NEBRASKA, 68113



REPLY TO
ATTN OF: LGMS (Maj Hartman, AV 271-2288)

15 JUL 1981

SUBJECT: Class IVB Modification, "Relocation of B-52H Interphone Connection"

TO: CC-AIC/MMRM (Mr. Bill Daniels)

Attached AF Form 1067 was approved by the SAC CCB on 12 Jun 81
and is furnished per your request.

Donald K. Nims
DONALD K. NIMS, COLONEL, USAF
CHIEF, AIRCRAFT SYSTEM DIV, DCS
LOGISTICS

1 Atch
AF Form 1067, Control
No. B810077

Cy to: LGMS

Peace is our Profession

B-8

ATCH 5

[illegible]

6. IMPACT (degree of need and impact if not satisfied)

1. PROPOSED SOLUTION

Best Available Copy

A. UNIT COST		B. TOTAL COST		C. UNIT WORK HOURS		D. TOTAL WORK HOURS	
\$31.03		\$2978.88		4.5		432	
E. NO OF CH AFFECTED		F. LEAD TIME		G. TOTAL CH'S FILL ROLL		H. TOTAL USAF INVENTORY	
MAJCOM 96 USAF 96				MAJCOM USAF		96	
I. LEVEL OF ACCUMULATION							
PRODUCTION ☒		ON MAINTENANCE ☐		DEPOT ☐		CONTRACTOR ☐	
OTHER ☐							

10. REMARKS (if more space is needed, continue on plain paper and identify by item No.)

21. UNIT APPROVAL		
DATE	TYPE NAME, GRADE, TITLE AND DUTY PHONE	SIGNATURE

22. CCB ACTION HISTORY/MAJCOM REMARKS

Certified mission essential for reasons stated in block 16.

[Signature]
JAMES E. LIGHT, JR.
Major General, USAF
Deputy Chief of Staff Logistics

23. MAJCOM CCB ACTION

APPROVED / ~~DISAPPROVED~~

24. MAJCOM CCB COORDINATION/CERTIFICATION					
DATE	OFFICE SYMBOL	NAME AND GRADE	DATE	OFFICE SYMBOL	NAME AND GRADE
12 JUN 81	LGMS	<i>[Signature]</i>	12 JUN 81	XPH	<i>[Signature]</i>
12 JUN 81	LGMA	<i>[Signature]</i>	12 JUN 81	XPHV	<i>[Signature]</i>
12 JUN 81	LGME	<i>[Signature]</i>	12 JUN 81	XPHD	<i>[Signature]</i>
	DOT		12 JUN 81	XPHN	<i>[Signature]</i>
	DOTT		12 JUN 81	XOB	<i>[Signature]</i>
12 JUN 81	DOTP	<i>[Signature]</i>	12 JUN 81	ICW	<i>[Signature]</i>
	DOCA		12 JUN 81	ICF	<i>[Signature]</i>
12 JUN 81	DOBT	<i>[Signature]</i>			
12 JUN 81	LCMT	<i>[Signature]</i>			

25. MAJCOM APPROVAL AUTHORITY		
DATE	CCB Approval from Deputy Director of Aircraft	SIGNATURE
12 JUN	Deputy Director of Aircraft	<i>[Signature]</i>

B-10

Best Available Copy

SANRT (W Sisson/54594) 13 Mar/ec

Mar 16 1970

Value Engineering Project No SAVE 6-102, Synthetic
Rubber Aircraft Wheel Chock

2750 AR Wg (EWM)
Wright-Patterson AFB OH 45433

1. Reference is made to your letter (EWMV), 23 Mar 1966, and letter from AFLC (MCNK), 6 Feb 1970.
2. A service test has been completed of a "D" shaped, yellow, extruded rubber chock, drilled at one end to accept a rope and slotted at the other end (manufactured by Goodyear) and a molded plyfoam chock constructed with a plyfoam core and covered with epoxy resin.
3. The project evaluation was carried out by two organization, each having different aircraft assigned and located in areas of different climate conditions. The test chocks were used with aircraft tires of varying sizes, pressures and volumes, to gather as complete a sampling of information as possible. Although evaluation was carried out with two different types aircraft, both of which use dissimilar tires (F-105 high pressure tires, C-130 low pressure tires), the findings, with few exceptions, were almost identical. Mixed sets of chocks were assigned to aircraft for utilization (one wood chock was paired off with each rubber and plyfoam chock). Special tests were also conducted on the chocks to gather any additional information which would help in the formulation of a final recommendation by this Headquarters. Chocks used primarily in the test were the 20 inch variety. The 14 inch chocks were utilized on transient aircraft and yielded almost identical results.
4. Project results revealed the performance of the extruded rubber and plyfoam chocks were satisfactory in the majority of the performances; however, the overall performance, handling characteristics, and their acquisition cost were not acceptable. The critical nonacceptable performance of the rubber and plyfoam chocks in gripping power. The test proved the wood chock gripping capability is superior to either the rubber or plyfoam chock on snow and ice.
5. Based on the foregoing, the decision has been made to retain wood as the acceptable material from which chocks will be fabricated. We appreciate your support and interest in improving the equipment.

FOR THE COMMANDER

Signed
JOHN M. BRUNER, Chief
Technical Services Branch
AGE Section
Director Material Management

Copy to:
AMFC (MCNE)

(Retyped due to poor quality of original)

C-1

ATCH 6

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS WARNER ROBINS AIR MATERIEL AREA (AFLC)
ROBINS AIR FORCE BASE, GEORGIA 31093



JAN 21 1970

REPLY TO
ATTN OF: WRNEPG

SUBJECT: AGE Maintenance Evaluation Program Project ES/EW 67-20, Aircraft
Wheel Chocks

TO: SAAMA (SANRTB)

1. Aircraft wheel chocks were evaluated by the Maintenance Evaluation Program in TAC and SAC MEP Evaluation Activities from 10 Apr 68 through 30 Jul 69. Two commercial chocks were evaluated on comparison basis in terms of effectiveness, reliability and ease of handling with wood chocks conforming to AF Dwg 42D6594. The following commercial chocks were evaluated:

a. A "D" shaped yellow extruded rubber chock drilled at one end to accept a rope and slotted at the other end. Evaluation of the extruded rubber chock manufactured by Goodyear Tire and Rubber Co., Akron, Ohio was requested by SAAMA. The manufacturer furnished chocks in 14", 20" and 56" lengths.

b. A molded plyfoam chock constructed with a laminated plyfoam core and covered with epoxy resin. This chock is molded to conform to the details of AF Dwg 42D6594 including the rope hole and slot. The plyfoam chock is manufactured by Fibercraft Products Co., Detroit, Michigan. Hq TAC requested the project be expanded to include the plyfoam chock. The manufacturer furnished the 14" and 20" chocks for evaluation.

2. Comparative characteristics and capabilities of the three chocks discovered during the evaluation:

a. Chock weights.

	14"	20"	56"
Wood	8½ lbs	12½ lbs	37½ lbs
Rubber	9½ lbs	23½ lbs	64 lbs
Plyfoam	6 lbs	14½ lbs	Not available

b. Chocking capabilities. The rubber, plyfoam and wood chocks have excellent holding capability on dry and wet concrete or asphalt surfaces and good capability in soft slush snow. On hard packed snow and ice, holding capability of the rubber chock was rated very poor, plyfoam fair and wood only slightly better than plyfoam.

c. Safety Precautions. The same safety precautions are required in use of the plyfoam chock as exercised when placing the wood chock under aircraft wheels. The weight of the rubber chock, specifically the 56" chock, is so excessive that their use during launching or parking of an aircraft with engines running constitutes a personnel safety hazard. Care should be taken when lifting the 56" chocks on and off vehicles to avoid backstrain or other injuries. Rubber chocks are difficult to remove when placed snugly against a wheel before aircraft fueling or loading operations. The hollow center depresses with the increased aircraft weight which makes the rubber chock difficult to remove.

d. Special Tests. (1) One set of wood, rubber and plyfoam chocks were subjected to temperatures ranging from 0° F to -10° F for eleven days. (New wood chocks with no visible deficiencies were selected for this test). The chocks were removed and subjected to harsh pounding with a three-pound hammer. When this had been accomplished and no adverse results were noted, the chocks were subjected to a drop test. The chocks were repeatedly raised 15 feet above the concrete floor and allowed to drop and impact on the floor below. The 14" wood chock cycled 203 times before breaking up. The 23" wood chock withstood 178 cycles before failure. The plyfoam and rubber chocks, in the 14" and 20" lengths, were cycled 300 times. No visible damage to these chocks could be detected as a result of this test.

(2) The rubber and plyfoam were run over several times with a heavy (Uke) aircraft towing tractor. The rubber chocks would crush but would return to original configuration with no visible adverse conditions. The plyfoam chock deformed slightly and developed small cracks in the covering. What effect these cracks would have on the chock life could not be ascertained during the evaluation. However, we believe the cracks would progress rapidly with age and result in early failure due to deterioration of the inner core.

e. Cost Comparison. Cost to locally manufacture wood chocks varies with the locality. The average local manufacture cost is reflected. Commercial chock price quoted is for quantities 1 through 49 each.

	<u>14"</u>	<u>20"</u>	<u>56"</u>
Wood	\$ 2.28	\$ 2.73	\$ 5.18
Rubber	\$11.00	\$32.21	Not specified
Plyfoam	\$25.00	\$50.00	\$125.00

✓ f. Life Expectancy. The usable life of wood chocks varies according to use. The maximum life of a wood chock is 15 months. Average life is estimated as 9 months. The life expectancy of rubber and plyfoam chocks is considered indefinite.

g. Rope Comparison. The nylon and cotton ropes proved equally satisfactory in wear and use characteristics. However, Evaluation Activities have been using $\frac{1}{2}$ " twisted polyethylene rope (FSN 4020-710-2076) for chock rope and find it superior to cotton and nylon rope.

3. Data from the project indicates each Air Force Base expends from \$100.00 up per month for manufacture of aircraft wheel chocks. When the total number of bases are considered, the annual Air Force expenditure for wheel chocks becomes impressive. The need for a cost reduction in this area is apparent. However, commercial aircraft wheel chocks presently available do not offer a solution.

h. Based on project findings, adoption of commercial (rubber or plyfoam) aircraft wheel chocks for Air Force use is not recommended. Your concurrence/comments relative to our recommendation in accordance with AFR 66-8/AFIC Sup 1 is required. An early reply would be appreciated.

FOR THE COMMANDER

H. M. Thompson
H. M. THOMPSON
Chief, Maintenance
Evaluation Program Branch
Service Engineering Division

3 Atchs

1. Photo of wood chock
2. Photo of extruded rubber chock
3. Photo of Plyfoam chock

Cy to: (w/o Atchs)
USAF (AFSMEMS)
AFIC (MCNRR1-1)
SAMA (SANEM)

initial cost high but no recurring cost.

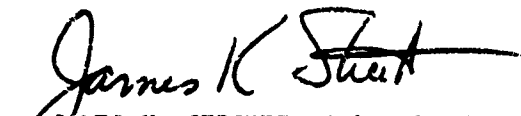
HQ SAC/LGME TEST PLAN
NUMBER: P-328-T-2

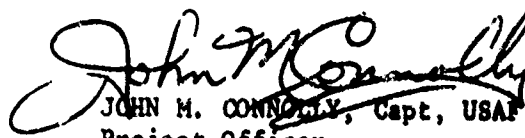
AIRCRAFT ENGINEERING DIVISION (LGME)
Offutt Air Force Base Nebraska 68113

Maintenance Posture for QUICK START

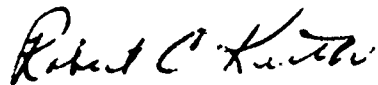
80 JAN 1980

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3. BACKGROUND	2
4. MODIFICATION	2
5. TEST PROCEDURES	3
6. ENVIRONMENTAL IMPACT	4
7. TEST SCHEDULE AND DURATION	4
8. RESPONSIBILITIES	4
9. POINTS OF CONTACT	4
10. IMPLEMENTING ACTIONS	5
11. REPORTING	5


JAMES K. STREETT, Colonel, USAF
Chief, Aircraft Engineering Division
Directorate of Aircraft Maintenance


JOHN M. CONNOLLY, Capt, USAF
Project Officer
Aircraft Systems Branch

APPROVED:



ROBERT C. KEITH, Colonel, USAF
Director of Aircraft Maintenance
DCS/Logistics

D-1

ATCH 7

1. **PURPOSE:** To evaluate the effectiveness of a taxi-over chock on ice.

2. **AUTHORITY AND COORDINATION:** This test is a part of HQ SAC/LGME project P-328, Maintenance Posture for QUICK START, which is being conducted under the provisions SACR 80-2. The project was approved by HQ SAC/LGM on 12 Jun 78.

3. **BACKGROUND:**

a. The QUICK START modification to the B-52G/H and KC-135 model aircraft has been completed to allow simultaneous starting of all engines. This modification, however, produces an excessive amount of smoke and toxic gas. After extensive testing, it was found that the environment within 100 feet of the aircraft using QUICK START is harmful to unprotected personnel for up to 60 seconds after initiation. This test is part of an in-depth project to develop means of protecting the ground crew from the hazardous environment.

b. As a result of HQ SAC/LGME study S-096, Aircraft Parking Restraint for QUICK START, a taxi- (roll) over type chock was designed and manufactured. Utilization of this type chock is intended to relieve the ground crew from the responsibility of pulling chocks prior to aircraft taxi, thus limiting their exposure to the toxic gases from the starter exhausts.

c. Previous testing of the chock proves it performs successfully on dry concrete. Roll-over chocks are currently authorized for use on cocked alert aircraft at SAC units selected to implement QUICK START procedures. The chocks are ineffective on ice and are restricted from use under icy ramp conditions. Previous testing on ice shows an aircraft is restrained until the complete surface of the tire is on the chock. At this point, the tire will rotate backwards (trying to roll back down the chock) and spit the chock forward. In order to function properly on ice, an anti-skid surface must be placed between the chock and the ice.

4. **MODIFICATIONS:**

a. Apply sealing compound (MIL-S-8802) mixed with coarse walnut shells, to the bottom surface of two (one set) chocks. Surface preparation and sealant application instructions are contained in Attachment 1. LGME will supply the walnut shells. Supply information is contained Attachment 3.

b. Apply walkway compound (MIL-W-5044 Type II) to the bottom of two (one set) chocks. Prepare the chock surface as described in Attachment 2. Use only Type II compound, with grit. Supply information is contained in Attachment 3.

c. Manufacture two frames using 3/4" angle iron approximately 61" X 19" (see Attachment 4). Use a roll-over chock for exact dimensions, because the chock's overall length could vary as much as four inches. Butt weld the corners. Place a 60" X 18" sheet of expanded metal inside the frame and tack weld in several places. Notch the 19" pieces of angle iron so the nuts on

both sides of the chock do not contact the angle iron. When complete, the bottom of the chock will rest completely on the expanded metal. Sufficient clearance should exist around the chock to allow for easy installation and removal.

5. TEST PROCEDURES:

a. There are no operational changes or restrictions imposed by this test.

b. The 416BMW is selected to conduct the test due to their winter environment, and experience using the roll-over chocks. One KC-135A and one B-52G will be required for the test. Each must be fueled to maximum ground handling weight (KC-135A, 296,000 lbs, B-52G, 490,000 lbs).

c. Anti-skid designs will be tested in the following order:

(1) Chocks modified with MIL-S-8802, sealing compound and walnut shells.

(2) Chocks modified with MIL-W-5044 walkway compound.

(3) Several combinations of expanded metal (supplied by LGME) placed under the chock.

(4) Sand placed under the chock.

(5) Any other suggested designs which can be produced prior to the test date. These designs must be approved by the LGME project officer prior to testing.

As stated in paragraph 3c, if the anti-skid surface fails, the chock may spit forward. Consequently, testing will be accomplished in two phases. The KC-135A test will be accomplished first. If the chocks spit out, their forward motion will be limited by the number 1, 2, 3, and 4 tires. The anti-skid combinations successfully passing this phase will then be tested on the B-52G.

d. The complete surface of both chocks must be in contact with ice. The aircraft will taxi over the chocks several times; therefore, an area with several ice patches should be selected for the test. This will prevent towing the aircraft back on the ice after each taxi.

e. Aircraft engines will be started using normal pneumatic starting procedures. The aircraft commander will taxi the aircraft to the test site, if not already prepositioned. The aircraft commander can terminate testing at any time aircraft operation is not safe.

f. The primary aircraft marshaller is responsible for overall safe ground operation. Two assistant ground safety observers will be located on opposite sides of the aircraft and in constant view of the marshaller. Standard aircraft marshalling signals will be used. In the event of

material or design failure, the marshaller will terminate the test until the deficiency is corrected.

6. ENVIRONMENTAL IMPACT: There are no anticipated environmental impacts as a result of this test.

7. TEST SCHEDULE AND DURATION: Due to the icy ramp requirement, weather is the driving factor in selecting an actual test date. The last two weeks in February may provide the optimum timeframe. A maximum of four hours per aircraft should be sufficient time to complete all test requirements.

8. RESPONSIBILITIES:

a. HQ SAC/LGME will:

(1) Provide the 416BMW project officer with the expanded metal and walnut shells required for the test.

(2) Conduct the service test.

(3) Evaluate the test data and recommend action.

b. 416BMW/MA/DO will:

(1) Appoint a logistic and operations project officer and forward names, office symbols, and telephone extensions to HQ SAC/LGME project officer, by message.

(2) Provide one KC-135 and one B-52G configured to maximum ground handling weight for the test.

(3) Provide a sufficient number of qualified ground crewmen and necessary support equipment to assist the HQ SAC/LGME test monitor as required.

(4) Provide a qualified KC-135 and B-52 aircraft taxi crew for the duration of each test.

(5) Provide a safety observer from the wing's safety office to participate in the test.

(6) Provide a standby radio equipped fire vehicle during conduct of the test.

c. The 416BMW project officers will establish and maintain close coordination with the HQ SAC/LGME project officer to ensure aircraft and personnel support is available on the test date based on forecasted weather conditions.

9. POINTS OF CONTACT: Capt Connolly, HQ SAC/LGMES, AV 271-3750/4783.

10. IMPLEMENTING ACTIONS: The actual exercise date is primarily dependent upon forecasted weather. Maximum telecon coordination between all participants is authorized and encouraged. Once a test date has been selected, the HQ SAC/LGME representative, upon his arrival, will brief the wing project officers and test participants on the conduct of the test.

11. REPORTING: Reports are not required by the unit.

DISTRIBUTION:

9 - HQ SAC/LGMM/LGMS/LGMT/
DOTT/IGOL/IGFF/IGFG/DOBT/DOOA
2 - 8AF/LG/DO, Barksdale AFB LA 71110
2 - 15AF/LG/DO, March AFB CA 92508
2 - 45AD/LG/DO, Pease AFB NH 03801
5 - 416BMW/MA/MAO/DO/DOS/MAF,
Griffiss AFB NY 13440

4 Atch

1. MIL-S-8802
Application
2. Walkway Compound
Application
3. Supply Information
4. Drawing

MIL-S-8802 APPLICATION

1. Clean dirt and heavy amounts of oil from bottom surface of chocks.
2. Rough surface with coarse sandpaper to remove loose and glossy paint.
3. Groove the surface length-wise (60" length) approximately 1/8" deep. Keep grooves approximately 1" apart.
4. Brush on a thin sanding sealer coat. Lightly sand when dry.
5. Mix sealant, MIL-S-8802, per manufacturer's instructions. Either Class A or B sealant is acceptable; however, Class A is brushable and may be easier to mix and apply.
6. Add coarse walnut shells to the sealant.

NOTE

The correct amount of walnut shells will have to be by trial and error. Using a smaller quantity of MIL-S-8802, try several mixtures of walnut shells applied to a piece of wood. The desired result is a very rough surface while keeping a good sealant bond.

7. Apply the mixture to the bottom of the chock approximately 1/8" thick. Fill in the grooves completely to help hold the sealant. Allow the chocks to cure completely for the type sealant used.

Atch 1

WALKWAY COMPOUND APPLICATION

1. Clean dirt and heavy amounts of oil from bottom surface of chocks.
2. Rough surface with coarse sandpaper to remove loose and glossy paint.
3. Brush on a thin sanding sealer coat. Lightly sand when dry.
4. Apply the compound to the bottom of the chock and allow to cure for 24 hours. Do not thin the compound.

Atch 2

D-7

SUPPLY INFORMATIONSealing CompoundMIL-S-8802

<u>STOCK NUMBER</u>	<u>WORKING TIME</u>	<u>CLASS</u>	<u>QUANTITY</u>	<u>PRICE</u>	<u>DRYING TIME</u>
8030-01-023-7470	1/2 hr	A-1/2	1 gallon	\$12.80	10 hr tackfree
8030-00-579-8453	1/2 hr	A-1/2	1 gallon	16.90	24 hour
8030-00-841-6832	2 hr	A-2	1 gallon	16.40	40 hr tackfree
8030-00-842-8127	1/2 hr	A-1/2	1 gallon	18.30	16 hr tackfree
8030-00-841-6831	1/2 hr	B-1/2	1 gallon	16.70	10 hr tackfree

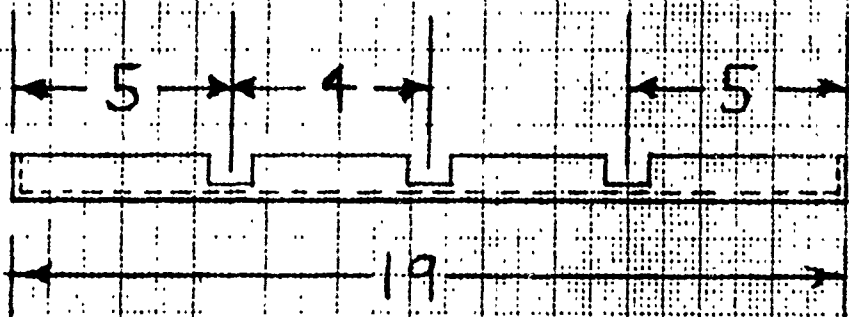
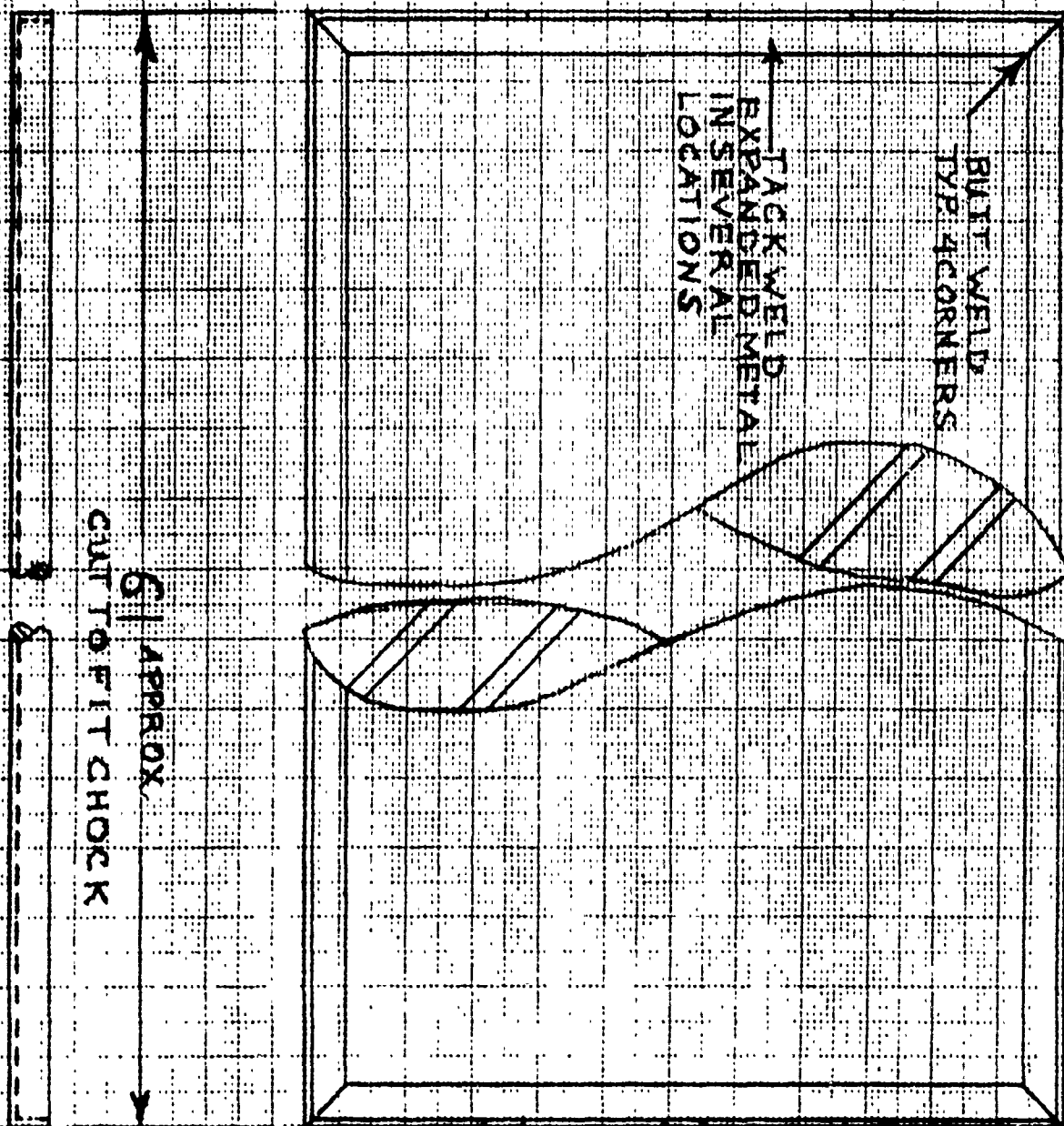
NOTE: Supply may be exhausted.

8030-01-039-8868	1/2 hr	B-1/2	1 quart	3.00	10 hr tackfree
8030-01-850-5717	4 hr	A-4	1 quart	5.00	48 hr <u>min</u> tackfree
8030-01-035-9340	1/2 hr	A-1/2	1 quart	3.00	16 hr tackfree
8030-00-685-0915	2 hr	A-2	1 quart	5.30	24 hr tackfree
8030-00-753-5006	2 hr	B-2	2 ounces	2.10	40 hr tackfree
8030-00-753-5007	1/2 hr	B-1/2	2 ounces	2.00	10 hr tackfree
8030-00-753-5008	1/2 hr	A-1/2	2 ounces	3.20	10 hr tackfree

WALKWAY COMPOUNDMIL-W-5044 Type II

<u>STOCK NUMBER</u>	<u>COLOR</u>	<u>QUANTITY</u>	<u>PRICE</u>
5610-00-641-0427	Black	Gallon	\$5.50
5610-00-142-6525	Black	Quart	1.65
5610-00-641-0426	Dark Gray	Gallon	6.10
5610-00-141-7838	Olive Drab	Gallon	6.20

Atch 3



ALL DIMENSIONS
IN INCHES AND
ARE APPROX.
MANUFACTURE
TO FIT.
MATERIAL: 3/4" ANGLE
IRON.

ATTACH. IV

11111 M/M

REPORT OF VISIT		TYPE OF REPORT (Check One)		DATE OF REPORT 20 Jan 81																																								
		☐ STAFF ASSISTANCE VISIT ☒ LIAISON VISIT ☐ ORIENTATION		TRIP NO 28																																								
TO: LGME <i>gms</i>		PREPARING OFFICIAL Capt Connolly		DATE OF TRIP 15-17 Jan 81																																								
FROM: (Office Symbol) LGME				COORDINATION																																								
ORGANIZATION(S) OR STAFF AGENCY(IES) VISITED 416BMW Griffiss AFB NY		PERIOD OF VISIT (S) 15-17 Jan 81		OFFICE SYMBOL	LAST NAME																																							
				<i>LGME</i>	<i>Shick</i>																																							
PURPOSE OF VISIT (S) To test the effectiveness of roll-over chocks on glare ice that were modified with an anti skid surface.				DISTRIBUTION																																								
				<i>HQ SAC</i>																																								
				<i>LGME</i> <i>Plonick</i>																																								
				<i>LGMS</i>																																								
RESULTS Three sets (two each) of roll-over chocks were modified with an anti skid material per LGME test plan P-328-T-2 dtd 30 Jan 80. A KC-135 and a B-52G, fueled to approximately maximum ground handling weight, successfully taxied over all the modified chocks, which were placed on glare ice. See attached for chock modification, specific test procedures, conclusions, and recommendations.				<i>LGMM</i>																																								
				<i>LGMT</i>																																								
				<i>DOTT</i>																																								
				DISTRIBUTION																																								
NAME AND GRADE OF VISITORS		DUTY (Or Title)		UNIT OR AGENCY																																								
Capt Connolly		Project Officer		HQ SAC/LGMES																																								
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th> </th> <th>ACT</th> <th>INFO</th> </tr> </thead> <tbody> <tr><td>DIRECTOR</td><td> </td><td><i>3</i></td></tr> <tr><td>DEPUTY</td><td> </td><td><i>27</i></td></tr> <tr><td>ENCL</td><td> </td><td><i>1 gm</i></td></tr> <tr><td>ADMIN</td><td> </td><td> </td></tr> <tr><td>SECY</td><td> </td><td> </td></tr> <tr><td>LOGA</td><td> </td><td> </td></tr> <tr><td>LGME</td><td> </td><td> </td></tr> <tr><td>LGMS</td><td> </td><td>✓</td></tr> <tr><td>LGMM</td><td> </td><td>✓</td></tr> <tr><td>LGMT</td><td> </td><td>✓</td></tr> <tr><td>LGML</td><td> </td><td> </td></tr> <tr><td>LGMD</td><td> </td><td> </td></tr> </tbody> </table>			ACT	INFO	DIRECTOR		<i>3</i>	DEPUTY		<i>27</i>	ENCL		<i>1 gm</i>	ADMIN			SECY			LOGA			LGME			LGMS		✓	LGMM		✓	LGMT		✓	LGML			LGMD			SIGNATURE <i>John M Connolly</i>		<i>ATCH</i> 8	
	ACT	INFO																																										
DIRECTOR		<i>3</i>																																										
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LGML																																												
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NAME, GRADE & TITLE (Team Chief or Visitor)																																												
JOHN M. CONNOLLY, Capt, USAF Project Officer																																												

1. The chocks were modified with three different anti skid materials. Walkway compound, with grit, was applied to the bottom of one set (two each) of chocks. Sealant compound (MIL-S-8802), mixed with crushed walnut shells, was applied to another set of chocks. For the third set of chocks, a 3/4" angle iron frame was manufactured to fit each chock. Expanded metal was tack welded on the bottom, inside portion of the frame. The chock was placed inside the frame and the assembly was held together with several small screws.

2. In order to conduct the test on glare ice, the fire department made three patches of ice on the taxiway, that were separated by approximately 100 ft of dry concrete. The first two ice patches were about 10-20 ft long by 40 ft wide. The third ice patch was about 100 ft long and 40 ft wide. One set of chocks were tested on each ice patch in the following order; walkway compound, sealant with walnut shells, and the angle iron/expanded metal assembly.

3. The KC-135 was fueled to a gross weight of 293,620 pounds and the B-52G was fueled to approximately 490,000 pounds. The taxi tests were performed in two distinct phases, with the KC-135 taxiing first. The B-52 held engine start until the KC-135 successfully taxied over the third set of chocks. On the 100 ft long ice patch, the aircrews performed a controllability check of the aircraft, due to the extra thrust required to taxi over the chocks. Once over the chocks, engine power was immediately reduced to idle, and aircraft brakes were applied. In both cases, the wheels locked and overall stopping distance was significantly longer than normal taxi conditions on ice. In addition, the B-52 crew attempted a right turn on the ice. The aircraft did not respond until the forward main landing gear contacted the dry concrete.

4. After the tests, the crews commented on using the chocks in the winter as compared to their experiences during summer operation. Both crews agreed that the chocks should not be used on icy surfaces where the aircraft must make a 90° turn, from the parking stub to the taxiway. The extra momentum, caused by the required increased engine thrust would make this turn difficult to negotiate safely. The chocks could be used in a parking area where the aircraft has a straight, or almost straight, shot for the taxiway, if immediate braking was not required.

5. Conclusions:

a. All three anti skid designs successfully held the roll-over chocks in place on the glare ice, while the aircraft taxied over.

b. The angle iron frame appears to be the optimum design, due to the extra gripping power of the sharp steel on the ice.

c. Crew chief injuries from falling on the ice while removing stuck standard chocks could be eliminated by using the roll-over chocks.

d. Aircraft control on the ice is more difficult due to the increased thrust required to taxi over the chocks.

6. Recommendations:

a. The angle iron/expanded metal anti skid design should be used with roll-over chocks on ice and snow covered ramps.

b. The chocks should be restricted from use on ice and snow covered areas where the aircraft must make a 90° turn from the parking stub to the taxiway.

c. If adopted, the angle iron frame design should be operationally tested at one unit, for an entire winter season, prior to further implementation.

d. If adopted, additional warnings or cautions may be required in applicable dash one technical orders concerning aircraft operation on ice when higher than normal power settings are required.

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