TP 14318E

Joint Winter Runway Friction Measurement Program (JWRFMP)

International Runway Friction Index (IRFI) versus Aircraft Braking Coefficient (Mu)

Prepared for
Transportation Development Centre
of
Transport Canada,
National Aeronautics and Space Administration,
and
Federal Aviation Administration

September 2003

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Un sommaire français se trouve avant la table des matières.

Transport Canada / Transports Canada

PUBLICATION DATA FORM

1. Transport Canada Publication No.	2. Project No.	3. Recipient's Catalogue No.
TP 14318E	9555	

4. Title and Subtitle	5. Publication Date
Joint Winter Runway Friction Measurement Program (JWRFMP): International Runway Friction Index (IRFI) versus Aircraft Braking Coefficient (Mu)	September 2003
	6. Performing Organization Document No.
7. Author(s)	8. Transport Canada File No.
James C. Wambold and J. J. Henry	2450-BP-14
9. Performing Organization Name and Address	10. PWGSC File No.
CDRM Inc. 1911 East College Avenue P.O. Box 1277 State College, Pensylvania U.S.A. 16804	MTB-2-01655 11. PWGSC or Transport Canada Contract No. T8200-2-2539/001/MTB
12. Sponsoring Agency Name and Address	13. Type of Publication and Period Covered
Transportation Development Centre (TDC) 800 René Lévesque Blvd. West Suite 600 Montreal, Quebec H3B 1X9	Final 14. Project Officer A. Boccanfuso

15. Supplementary Notes (Funding programs, titles of related publications, etc.)

Co-sponsored by NASA, the FAA and Transport Canada's Aerodrome Safety Branch

16. Abstract

This is a Joint Winter Runway Friction Measurement Program (JWRFMP) report on aircraft and ground friction measuring device (GFMD) research and data collection as related to the capability of a runway surface to provide aircraft wheel-braking action during winter operations. The project was led by Transport Canada and the National Aeronautics and Space Administration, with support from National Research Council Canada, the U.S. Federal Aviation Administration, the Norwegian Air Traffic and Airport Management (now Avinor), France's Direction générale de l'aviation civile, and organizations and equipment manufacturers from Austria, Canada, France, Germany, Norway, Scotland, Sweden, Switzerland, and the United States.

The data was used to compare the International Runway Friction Index (IRFI) of the GFMDs with the Aircraft Braking Coefficient (Mu). During the year 2000, ASTM E 2100 standard "The International Runway Friction Index" was issued. The use of IRFI reduced the standard error in measured friction of GFMDs from as high as 0.2 (without IRFI) to an average under 0.05. IRFI correlations to the aircraft reduced the variations of the slopes of the correlations by 50 percent as compared to GFMDs without IRFI.

17. Key Words	18. Distribution Statement
International Runway Friction Index, IRFI, statistical analysis, aircraft braking performance, winter runway conditions, ground vehicle friction measurement, aircraft braking coefficient, ground friction measuring device, GFMD	Limited number of copies available from the Transportation Development Centre

19. Security Classification (of this publication)	20. Security Classification (of this page)	21. Declassification (date)	22. No. of Pages	23. Price
Unclassified	Unclassified	—	xviii, 28, apps	Shipping/ Handling

CDT/TDC 79-005
Rev. 96

Canada

Transports Canada | Transport Canada

FORMULE DE DONNÉES POUR PUBLICATION

1. N° de la publication de Transports Canada TP 14318E	2. N° de l'étude 9555	3. N° de catalogue du destinataire
4. Titre et sous-titre Joint Winter Runway Friction Measurement Program (JWRFMP): International Runway Friction Index (IRFI) versus Aircraft Braking Coefficient (Mu)		5. Date de la publication Septembre 2003 6. N° de document de l'organisme exécutant
7. Auteur(s) James C. Wambold et J. J. Henry		8. N° de dossier - Transports Canada 2450-BP-14
9. Nom et adresse de l'organisme exécutant CDRM Inc. 1911 East College Avenue P.O. Box 1277 State College, Pensylvania U.S.A. 16804		10. N° de dossier - TPSGC MTB-2-01655 11. N° de contrat - TPSGC ou Transports Canada T8200-2-2539/001/MTB
12. Nom et adresse de l'organisme parrain Centre de développement des transports (CDT) 800, boul. René-Lévesque Ouest Bureau 600 Montréal (Québec) H3B 1X9		13. Genre de publication et période visée Final 14. Agent de projet A. Boccanfuso

15. Remarques additionnelles (programmes de financement, titres de publications connexes, etc.)

Coparrainé par la NASA, la FAA et la Direction de la Sécurité des aérodromes

16. Résumé

Le présent rapport émane du Programme conjoint de recherche sur la glissance des chaussées aéronautiques l'hiver (PCRGCAH). Il rend compte d'études et de collectes de données effectuées à l'aide d'avions et d'appareils de mesure du coefficient de frottement (GFMD, *ground friction measuring device*) dans le but d'établir un lien entre la surface d'une piste et l'efficacité des freins de roue d'un avion sur cette piste, l'hiver. Le projet a été réalisé sous la direction de Transports Canada et de la National Aeronautics and Space Administration, appuyés par le Conseil national de recherches du Canada, la Federal Aviation Administration des États-Unis, Avinor (autrefois la Norwegian Air Traffic and Airport Management) et la Direction générale de l'aviation civile de France. Des organismes et des fabricants de matériel d'Allemagne, d'Autriche, du Canada, d'Écosse, des États-Unis, de France, de Norvège, de Suède et de Suisse ont également participé au programme.

Les données ont servi à comparer l'Indice international de la glissance des pistes (IRFI, *International Runway Friction Index*), déterminé à l'aide de divers GFMD, avec le coefficient de freinage d'avions (Mu). En 2000, la norme ASTM E 2100, *Standard Practice for Calculating the International Runway Friction Index*, était publiée. L'utilisation de l'IRFI a réduit l'erreur type des valeurs de frottement mesurées par les GFMD, faisant passer celle-ci de 0,2 (sans IRFI) à une moyenne de moins de 0,05. Le fait d'appliquer l'IRFI aux valeurs des GFMD a permis de réduire de moitié l'écart entre les pentes des fonctions de corrélation GFMD-avions, par rapport aux valeurs des GFMD sans IRFI.

17. Mots clés Indice international de la glissance des pistes, IRFI, analyse statistique, performance de l'avion en freinage, état de la surface de pistes en hiver, mesure du frottement par un véhicule au sol, coefficient de freinage de l'avion, appareil de mesure du coefficient de frottement, GFMD	18. Diffusion Le Centre de développement des transports dispose d'un nombre limité d'exemplaires.

19. Classification de sécurité (de cette publication) Non classifiée	20. Classification de sécurité (de cette page) Non classifiée	21. Déclassification (date) —	22. Nombre de pages xviii, 28, ann.	23. Prix Port et manutention

ACKNOWLEDGEMENTS

The authors are indebted to Transport Canada and National Research Council Canada for reviewing the report material and giving many valuable comments on the subject material and format of the report, and to Transport Canada and NASA for securing the funding for the Joint Winter Runway Friction Measurement Program (JWRFMP). Also, thanks are due to the many members of the JWRFMP and the aviation community for their assistance and advice.

EXECUTIVE SUMMARY

Measuring the capability of a runway surface to provide aircraft wheel-braking action is fundamental to airport aviation safety, especially under winter conditions. The different seasons, mainly winter, result in the possibility of the runway having contaminants of varying natures and qualities that contribute to reduced braking friction capabilities. A service is warranted for the measurement of winter surface friction, because the operational window for aircraft movement can change quite rapidly and frequently in the winter.

In the past, users of friction information have generally perceived the quality of the friction measurement service as poor. Often, these users have indicated that the reported friction values do not represent the actual braking friction that is experienced with aircraft tire braking.

International research of friction measurement confirmed that ground friction measuring devices (GFMD) measure and report different friction values for the same surface. Differences occurred among units of the same generic device as well as across different device types. The perception of non-uniformity was compounded by surfaces exhibiting large variances in reported values. These variances further augmented the differences among device types.

Measurements of friction were not calibrated to a common scale in the past. Also, being a non-dimensional ratio of forces, they were never associated with units of a scale, which could be another reason for the resulting differences. Ultimately, dynamic friction measurement results in the highest accuracy, but the procedure is limited to machine component calibrations. Research over the past four years has made significant advances toward solving these problems. Methods of measurement are being improved to increase measurement quality, remove uncertainties, and provide better correlation to aircraft tire braking. Prototype methods that incorporate GFMDs have shown promising results.

This study was part of a government/industry project called the Joint Winter Runway Friction Measurement Program, led by the National Aeronautics and Space Administration and Transport Canada. Support is received from National Research Council Canada, the U.S. Federal Aviation Administration, Avinor (formerly the Norwegian Air Traffic and Airport Management), and France's Direction générale de l'aviation civile. Organizations and equipment manufacturers from Australia, Austria, Canada, Czech Republic, England, France, Germany, Japan, Norway, Scotland, Sweden, Switzerland, and the United States are also participating.

Objectives of the project include:

- Compiling a database containing all test data available from ground vehicles and aircraft that participated in the winter and summer runway friction programs.
- Using the data to determine a harmonized runway friction index: the International Runway Friction Index (IRFI).
- Determining the relationship between aircraft stopping performance and ground vehicle IRFI.

The objective of this report is to present the results of a comparison of aircraft braking performance and the IRFI of ground vehicle measurements.

Statistical IRFI Model

Normally, regression techniques would be used to find relationships between the reported friction values of pairs of ground friction measurement devices. Such a technique assumes that one device's interaction with a surface is similar to another device's interaction with the same surface. The device, or an algebraic transformation of reported friction values, such as the average friction of two or more devices, would be selected as a reference. All devices would then be compared to the reference device to establish transformation constants. A simple linear regression, as shown in the equation below, is seen as a first step, which can be applied by the aviation community. The following equation represents a linear regression of the data for each device to an IRFI reference:

$$\mu_{IRFI} = a + b \times \textit{device friction measurement}$$

where a is the intercept and b is the gradient that were determined by the regression to the reference device. Past attempts failed because the data were not acquired at the same time in the same wheel track. Also, the sample size was too small. Since 1998, the friction measurement and corresponding data collection have been carried out more systematically. Pairs of measurement devices run in a wave pattern so that they measure the same surface within 15 seconds of each other. However, even with this systematic approach there are considerable variations in the measured surface condition because of the lateral placement of the devices and the resulting effect of surface compaction. The database now includes over 41,000 friction measurements.

Stability of the Harmonization Method

The correlation constants were calculated for devices that participated in the 1998-1999 test seasons and were reported in the 1997-98 JWRFMP report (TP 13836E). The constants were calculated by combining the two years of data. However, in 2000, it was established that not only does a calibration not apply across similar types of devices, it changes from year to year for a particular device.

IRFI Correlations with Aircraft Braking Performance

Table 1 compares the zero intercepts and slope multiplier values of each GFMD before and after IRFI is applied. Clearly IRFI reduces the difference of each GFMD when compared to the reference. The average error of the difference of the slope multipliers from the reference is 0.14 without IRFI and 0.05 with IRFI (absolute error of 0.1), a 64% reduction in the error.

Table 1: Summary of Aircraft Correlations

	Device			IRFI(Device)		
Device	Zero Intercept	Slope Multiplier	R^2	Zero Intercept	Slope Multiplier	R^2
Reference	0.016	0.48	0.7	0.016	0.48	0.7
ERD	0.03	0.5	0.81	-0.023	0.64	0.8
IMAG	-0.005	0.49	0.73	-0.005	0.52	0.73
RUNAR	0.07	0.26	0.56	0.103	0.36	0.51
GT-TC	0.064	0.33	0.62	0.108	0.32	0.6
RFT	0.06	0.33	0.87	0.04	0.64	0.88
SFT79	0.07	0.34	0.6	0.08	0.39	0.61
SFT85	0.126	0.25	0.75	0.119	0.3	0.71
SFT212	0.178	0.23	0.52	0.13	0.37	0.89
SFT99	0.08	0.37	0.81	0.13	0.54	0.94

ASTM International Standard

The ASTM Standard E 2100-00 defines and prescribes how to calculate IRFI for winter surfaces. IRFI is a standard reporting index to provide information on tire-surface friction characteristics of the movement area to aircraft operators.

IRFI can be used by airport maintenance staff to monitor the winter frictional characteristics in support of surface maintenance actions.

The IRFI method typically reduces the present variations among different GFMDs from 0.2 down to 0.05 friction units.

Conclusions and Recommendations

A reference device, which is required for calibration, must be a dedicated device for this purpose only, and the aviation community must agree on its provision, ownership and services. The device chosen for the exercises to demonstrate that IRFI is possible was an IMAG device called the International Reference Vehicle (IRV). The IRV must be evaluated at some point for stability. If it is not stable with time, other references would need to be investigated. All harmonization constants will have to be reworked when a permanent IRFI reference has been designated. It is recommended that a reference device:

- Measure both force and torque;
- Have a high footprint contact pressure, greater than 500 kPa;
- Have variable or adjustable slip ratios up to 100%;
- Have a standard tire that is reproducible from tire to tire;
- Be equipped with an anti-skid system; and
- Be a trailer device that is compact for shipping and can be towed with most any truck.

IRFI does help reduce the differences between GFMDs when correlated to aircraft. The average difference is 0.14 without IRFI and 0.05 with IRFI (absolute error of 0.1), a 64% reduction in the difference. The project has shown that IRFI can be used to predict aircraft braking performance.

SOMMAIRE

Connaître l'adhérence d'une piste, c.-à-d. l'efficacité des freins de roue d'un avion sur cette piste, est essentiel à la sûreté des opérations aériennes sur les aéroports, particulièrement dans des conditions hivernales. Quelle que soit la saison, mais surtout en hiver, on peut trouver sur les pistes des contaminants de natures et de qualités diverses qui entraînent une diminution du frottement au freinage. Les conditions de décollage/ atterrissage peuvent changer tellement rapidement, et à une fréquence telle, l'hiver, que la constitution d'un service aéroportuaire de mesurage de la glissance des pistes est amplement justifiée.

Par le passé, les utilisateurs de données sur la glissance avaient une piètre opinion du service de mesure de la glissance des pistes. Ces utilisateurs se sont souvent plaints que les valeurs de glissance enregistrées n'avaient rien à voir avec le comportement des pneus des avions en freinage.

Des travaux de recherche sur la glissance des pistes menés à l'échelle internationale ont confirmé que pour une même surface, les appareils de mesure du coefficient de frottement (GFMD, *ground friction measurement device*) mesurent des valeurs différentes. Des écarts ont été observés non seulement entre les mesures prises par des appareils de différents types, mais aussi entre les mesures effectuées par un même appareil. Les valeurs enregistrées sur une même surface affichaient de larges écarts, ce qui ne contribuait aucunement à dissiper la perception de non-uniformité, et ces fluctuations étaient d'autant plus grandes que différents types d'appareils étaient utilisés.

À l'époque, on ne rapportait pas les mesures du frottement à une échelle commune. De plus, comme ces mesures représentaient un rapport de forces non dimensionnel, elles n'étaient jamais associées aux unités d'une échelle, autre explication possible des écarts enregistrés. Finalement, c'est la mesure du frottement dynamique qui donne la plus grande précision, mais cette procédure se heurte à une difficulté, soit le calage intégré des éléments de chaque appareil. La recherche menée ces quatre dernières années a grandement contribué à résoudre ces problèmes. Ainsi, grâce au perfectionnement des méthodes de mesure, les résultats sont de meilleure qualité et mieux corrélés avec la performance en freinage des pneus aéronautiques, et les incertitudes sont éliminées. Des méthodes novatrices utilisant des GFMD ont donné des résultats encourageants.

La présente étude s'inscrivait dans le cadre d'un projet mené conjointement par le gouvernement et l'industrie, intitulé Programme conjoint de recherche sur la glissance des chaussées aéronautiques l'hiver (PCRGCAH), piloté par la National Aeronautics and Space Administration et Transports Canada, appuyés par le Conseil national de recherches du Canada, la Federal Aviation Administration des États-Unis, Avinor (autrefois la Norwegian Air Traffic and Airport Management) et la Direction générale de l'aviation civile de France. Des organismes et des fabricants de matériel d'Allemagne, d'Angleterre, d'Australie, d'Autriche, du Canada, d'Écosse, des États-Unis, de France, du Japon, de Norvège, de la République tchèque, de Suède et de Suisse ont également participé au programme.

Objectifs du projet :

- Constituer une base de données contenant toutes les données d'essai recueillies par les véhicules de mesure au sol et les avions qui ont participé aux campagnes d'essais tenues aussi bien en hiver qu'en été.
- Utiliser les données pour établir un indice harmonisé de glissance des pistes, désigné Indice international de la glissance des pistes (IRFI, *International Runway Friction Index*).
- Définir la relation entre la distance d'arrêt des avions et l'IRFI dérivé d'un véhicule au sol.

Le présent rapport expose les résultats d'une comparaison entre la performance en freinage des avions et l'IRFI dérivé d'un véhicule au sol.

Modèle statistique de l'IRFI

Normalement, on se servirait de techniques de régression pour établir les relations entre les coefficients de frottement enregistrés par des paires de GFMD. Ces techniques supposent que l'interaction d'un appareil avec une surface s'apparente à l'interaction d'un autre appareil avec la même surface. L'appareil, ou une transformation algébrique de coefficients de frottement enregistrés, comme la moyenne des valeurs obtenues par deux ou plusieurs appareils, serait choisi comme appareil ou valeur de référence. Tous les appareils seraient alors comparés à l'appareil de référence pour l'établissement des constantes de transformation. Une régression linéaire simple (voir l'équation ci-après) pourrait constituer une première étape pour les milieux aéronautiques. L'équation ci-dessous représente une régression linéaire des données de chaque appareil sur les données d'un appareil de référence IRFI :

μIRFI = a + b x coefficient de frottement enregistré par l'appareil

où *a* est l'ordonnée à l'origine et *b* le gradient, déterminés par la régression sur l'appareil de référence. Les tentatives faites dans le passé pour développer un indice uniforme ont échoué parce que les données n'étaient pas recueillies en même temps dans les mêmes trajectoires de roues. De plus, les échantillons de données n'étaient pas assez grands. Or depuis 1998, la mesure des coefficients de frottement et la collecte des données correspondantes sont davantage systématiques. Ainsi, deux appareils de mesure sont lancés l'un à la suite de l'autre, de sorte qu'ils mesurent la même surface à 15 secondes d'intervalle. Mais, malgré cette approche systématique, il subsiste des écarts considérables entre les valeurs obtenues, car le fait de décaler latéralement les appareils produit, au nombre des appareils mis en œuvre, un effet de tassement de la surface. La base de données comprend maintenant 41 000 valeurs de frottement.

Stabilité de la méthode d'harmonisation

Des constantes de corrélation ont été calculées pour les appareils qui ont servi aux essais de 1998 et de 1999 (les données des deux années ont été combinées) et les résultats ont été présentés dans le rapport 1997-1998 du PCRGCAH (TP 13836E). Cependant, en 2000, il a été établi que non seulement une valeur obtenue avec un appareil ne peut s'appliquer à d'autres appareils semblables, mais qu'elle varie d'une année à l'autre pour un même appareil.

Corrélation de l'IRFI et de la performance en freinage des avions

Le tableau 1 compare les valeurs d'ordonnée à l'origine et de facteur de pente reliées aux GFMD, avant et après l'application de l'IRFI. Il ressort clairement que l'IRFI réduit l'écart entre chaque GFMD et le véhicule de référence. Ainsi, l'erreur moyenne de l'écart entre les facteurs de pente des GFMD et celui du véhicule de référence est de 0,14 sans l'IRFI, et de 0,05 avec l'IRFI (erreur absolue de 0,1), ce qui représente une diminution de 64 p. 100 de l'erreur.

Tableau 1 : Sommaire des corrélations IRFI/avion

	Appareil			Appareil avec IRFI		
Appareil	Ordonnée à l'origine	Facteur de pente	R^2	Ordonnée à l'origine	Facteur de pente	R^2
Référence	0,016	0,48	0,7	0,016	0,48	0,7
ERD	0,03	0,5	0,81	-0,023	0,64	0,8
IMAG	-0,005	0,49	0,73	-0,005	0,52	0,73
RUNAR	0,07	0,26	0,56	0,103	0,36	0,51
GT-TC	0,064	0,33	0,62	0,108	0,32	0,6
RFT	0,06	0,33	0,87	0,04	0,64	0,88
SFT79	0,07	0,34	0,6	0,08	0,39	0,61
SFT85	0,126	0,25	0,75	0,119	0,3	0,71
SFT212	0,178	0,23	0,52	0,13	0,37	0,89
SFT99	0,08	0,37	0,81	0,13	0,54	0,94

Norme ASTM

La norme ASTM E 2100-00 définit et prescrit la méthode de calcul de l'Indice international de glissance des pistes (IRFI) en conditions hivernales. L'IRFI est un indice harmonisé destiné à renseigner les exploitants d'aéronefs sur les caractéristiques d'adhérence pneu-surface dans les aires de mouvement pour aéronefs.

Le personnel d'entretien des chaussées aéronautiques peut aussi se servir de l'IRFI pour surveiller l'adhérence des pistes en hiver, et mieux décider des mesures d'entretien à appliquer.

La méthode IRFI permet généralement de réduire l'écart entre les valeurs obtenues à l'aide de différents GFMD, le faisant passer de 0,2 à 0,05 unité de frottement.

Conclusions et recommandations

L'appareil de référence nécessaire à l'étalonnage des appareils doit être un appareil affecté uniquement à cette fin, et la communauté aéronautique doit s'entendre sur l'achat, la propriété et l'exploitation de cet appareil. L'appareil choisi pour démontrer la validité d'un indice IRFI était l'IMAG, aussi appelé Véhicule de référence international (IRV, *International Reference Vehicle*). Il faudra, un jour ou l'autre, évaluer la stabilité de l'IRV. S'il devait s'avérer non stable, il faudrait alors étudier d'autres appareils. Toutes les constantes d'harmonisation devront être recalculées lorsqu'un appareil de référence IRFI aura été choisi définitivement. Il est recommandé qu'un appareil de référence :

- mesure à la fois la force et le couple;
- offre une pression de contact élevée, supérieure à 500 kPa;
- offre des taux de glissement variables ou réglables pouvant atteindre 100 p. 100;
- soit équipé de pneus standard;
- soit équipé d'un système anti-dérapage;
- soit du type remorque, peu encombrant (facile à transporter) et puisse être attelé à n'importe quel camion.

L'IRFI permet de diminuer l'écart entre les valeurs des GFMD corrélées avec les coefficients de freinage des avions. L'écart moyen est de 0,14 sans l'IRFI et de 0,05 avec l'IRFI (erreur absolue de 0,1), ce qui représente une diminution de 64 p. 100 de l'écart. Les travaux ont démontré que l'IRFI peut être utilisé pour prédire la performance en freinage des avions.

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DEFINITIONS AND NOMENCLATURE

Acronyms

ACI	Airports Council International
ALPA	Air Line Pilots Association
ASFT	Airport Surface Friction Tester, manufactured by ASFT, Sweden
ASTM	ASTM International
BV-11	Skiddometer (Bromsvagn "Braking Vehicle"), manufactured by Airport Equipment Company (AEC), Sweden
CRFI	Canadian Runway Friction Index
DGAC	Direction générale de l'aviation civile, France
DND	Department of National Defence, Canada
E-274	E-274 Locked Wheel Tester, manufactured by Dynatest and ICC, USA
ERD	Electronic Recording Decelerometer
ERDNissan	ERD mounted in a Nissan SUV
FAA	Federal Aviation Administration, USA
GFMD	Ground Friction Measuring Device
GT	GripTester, manufactured by Findlay Irvine, Scotland
IB	Bare Ice
ICAO	International Civil Aviation Organization
ICC	International Cybernetics, Inc., Florida, USA
IFI	International Friction Index
IMAG	Instrument de Mesure Automatique de Glissance, manufactured by DGAC, France
IRFI	International Runway Friction Index
IRV	International Reference Vehicle
ITTV	Instrumented Tire Test Vehicle – NASA, USA
JWRFMP	Joint Winter Runway Friction Measurement Program
Mu	Aircraft Braking Coefficient
NASA	National Aeronautics and Space Administration, USA
NATAM	Norwegian Air Traffic and Airport Management
NRC	National Research Council Canada
PTI	Pennsylvania Transportation Institute, USA
RFT	Runway Friction Tester manufactured by Dynatest, Michigan, USA
ROAR	Road Analyzer and Recorder, manufactured by Norsemeter a.s., Norway
RUNAR	Runway Analyzer and Recorder, manufactured by Norsemeter a.s., Norway
SARSYS	Scandinavia Airport System
SB	Bare Compacted Snow
SD	Compacted snow with a layer of loose snow
STBA	Service Technique des Bases Aériennes, France
SFT	Surface Friction Tester, manufactured by Saab AB, Sweden
SFT-TC79	1979 SFT owned by Transport Canada
TC	Transport Canada

Definitions:

device configuration, **n.** - a term used to designate the entire test system as used for any friction measurement; it includes, but is not limited to, type of device (force or torque measurements), tire type, size and inflation pressure, slip ratio, normal load and braking system control mode.

base surface, **n.** - the type of surface evaluated. There are four classes:
(1) bare pavement dry, (2) bare pavement wet, (3) bare compacted snow, and (4) bare ice.

surface, **n.** - a generic term used in the act of reporting frictional characteristics; it includes the base surface class and the base surface condition.

compacted snow, **n.** - a compressed solid mass of snow that is sufficiently strong to prevent a normally loaded tire operating in a rolling mode from penetrating to the pavement or breaking up the surface.

ice, **n.** - water with or without contaminants frozen into a continuous solid body with or without cracks.

local friction device, **n.** - a particular friction testing device used at a given location to measure friction; the friction values evaluated with this device may be calibrated to IRFI values to provide harmonization.

master friction device, **n.** - a particular friction testing device used at a given location to calibrate local friction devices; the friction values of this device must be calibrated to IRFI values.

movement area, **n.** - that part of the airport (aerodrome) used for take-off, landing and taxiing of aircraft, consisting of the manoeuvring area and the apron(s).

IRFI reference device, **n.** - a particular friction measuring device selected as a benchmark or reference; it is used to calibrate any local or master friction device to permit local friction device values to be converted to IRFI values for selected base surfaces.

harmonization, **n.** - the transformation of the outputs of different devices used for measurement of a specific phenomenon so that all devices report similar values.

1.0 INTRODUCTION

Measuring the capability of a runway surface to provide aircraft tire braking action is fundamental to airport aviation safety, especially under winter conditions. The different seasons, mainly winter, result in the possibility of the runway having contaminants of varying natures and qualities that contribute to reduced braking friction capabilities [1-5]. No satisfactory method or technique had been developed before the Joint Winter Runway Friction Measurement Program (JWRFMP) to predict the tire braking action of aircraft by using friction data collected by ground vehicles

Both Canada and the U.S Air Force used a standard measurement method, the James Brake Index (JBI), to predict required runway length. In recent years this index has been revised and renamed the Canadian Runway Friction Index in Canada. The U.S. Air Force later started using a Mu-Meter and now uses a GripTester.

This report gives the results of using the International Runway Friction Index (IRFI) to predict aircraft tire braking action by using friction data collected by ground vehicles.

JWRFMP is an international government/industry initiative led by Transport Canada (TC) and the National Aeronautics and Space Administration (NASA), with support from the U.S. Federal Aviation Administration (FAA), Avinor (formerly Norwegian Air Traffic and Airport Management (NATAM)), France's Direction générale de l'aviation civile (DGAC) and National Research Council Canada (NRC). Also participating are organizations and equipment manufacturers from Canada, the United States, Austria, Czech Republic, England, France, Germany, Norway, Scotland, Sweden, and Switzerland.

The primary objective is to perform instrumented aircraft and ground vehicle tests aimed at improving the safety of aircraft ground operations. One of the program goals is flight crew recognition of less-than-acceptable reported runway friction conditions prior to the "go/no go" or the "land/go around" decision point. With this goal in mind, related studies are being conducted to look at contaminant drag, effects of runway treatments on friction, and, especially, the harmonization of ground vehicle friction measurement. Harmonization will enable friction data to be reported to a unified common index worldwide, which will then be used to predict aircraft braking performance.

It is expected that dissemination, acceptance, and implementation of the test results throughout the aviation community will be facilitated by several organizations. These include the International Civil Aviation Organization (ICAO), ASTM International, the Joint Aviation Authority, the International Federation of Air Line Pilots Association, the Air Line Pilots Association (ALPA), the Air Transport Association, and Airports Council International (ACI).

JWRFMP probably has the most extensive runway friction data ever collected at temperatures of 0^{o}C and below. The data are being added to NASA's tire friction database. Through ASTM Committee E17 on Vehicle-Pavement Systems, the ASTM E 2100 standard for IRFI was developed, and is anticipated to become a standard used by airports to assess the condition of a runway under winter conditions.

After eight years of testing, with the participation of experts from several countries, a systematic, standardized approach has been developed to achieve harmonized friction measurements. This should lead to a methodology for predicting how aircraft tire braking compares in response to the most recent reported runway friction properties. This approach, which is recognized by many as the most viable, was introduced by several speakers at the International Meeting on Aircraft Performance on Contaminated Runways, held October 20-22, 1996, in Montreal.

The results reported in this document provide comparisons of different participating ground testers and aircraft tire friction data obtained from aircraft testing under winter runway conditions.

2.0 JWRFMP OBJECTIVES

In cooperation with other researchers from TC, NRC, NASA, and the FAA, the objective is to establish an International Runway Friction Index to harmonize all ground friction measurement so that the common values can be reported and used by airports around the world.

Program sub-objectives

- Compile a database containing all test data available on winter and summer runway friction measurements from different devices and tires, including data on aircraft tire braking performance.
- Use the data to develop a harmonized runway friction index.
- Determine the relationship between aircraft stopping performance and ground vehicle IRFI.

The objective of this report is to present the results of a comparison of aircraft braking performance and the IRFI of ground vehicle measurements.

3.0 EQUIPMENT TESTED

A variety of instrumented test aircraft and ground friction measuring devices (GFMD) have been used at different test sites in the U.S., Canada, Norway and Germany. The NASA B-737 and an NRC Dassault Falcon 20 aircraft were used during January and March 1996 at Jack Garland Airport in North Bay, Ontario. Seven GFMDs from six different countries collected comparable friction data for several winter runway conditions including dry, wet, solid ice, dry loose snow and compacted snow.

In the January-March 1997 winter season, similar tests were performed at North Bay with an FAA B-727, the NRC Falcon 20 and a De Havilland Dash 8 aircraft, together with 13 GFMDs. Data obtained during these investigations helped define the methodology for an IRFI to harmonize the friction measurements obtained with the different GFMDs.

In the January-February 1998 winter season, additional data were collected at North Bay, Ontario, with the Falcon 20 and Dash 8 aircraft, together with 11 different GFMDs, to further refine the IRFI methodology. Based on the Electronic Recording Decelerometer (ERD), a Canadian Runway Friction Index (CRFI) was established for use by pilots to determine their aircraft stopping distance under compacted snow and ice conditions. In March 1998 several different GFMDs participated in conducting nearly 800 test runs under compacted snow- and ice-covered surface conditions at a new test track facility located at Oslo Airport in Gardermoen, Norway.

During the January-March 1999 winter season, Falcon 20 aircraft and ground vehicle data were collected at North Bay. Also in 1999, NASA B-757 aircraft and GFMD data were collected at a new test site, Sawyer Airbase in Gwinn, Michigan. These tests were followed with additional GFMDs (9 different devices) that obtained friction data at the Ottar K. Kollerud test track at Oslo Airport in Gardermoen, Norway. Data from these tests were used to further refine and improve the IRFI methodology and define the present correlation constants in the IRFI standard. It is interesting to note that under similar runway conditions at these three different test sites, friction data from the same ground vehicles tested at all three sites were in close agreement and the IRFI methodology was further substantiated.

During the January-March 2000 winter season, one week of testing in North Bay, Ontario, involved the Falcon 20 aircraft and 10 GFMDs. Tests with an Aero Lloyd A320, Sabena Airlines A320, Deutsche British Airways B-737-300 and Fairchild/Dornier 328 aircraft were conducted at Munich Airport, Germany, February 21-25, 2000. Thirteen GFMDs participated in the Munich testing. In 2000, 60 test runs were conducted with five aircraft and over 1000 runs were completed with the ground vehicles.

In 2001 two sessions were conducted in North Bay, Ontario (January 27 to February 2, and March 20-22), and a third test session was conducted at Erding Air Force Base in Germany (February 26-March 2). During the first session in North Bay, ERD comparisons were made as well as tests between ERD and the International Reference

Vehicle (IRV), and IRFI validation runs. In the second session, a NAV CANADA Dash 8 was tested. During the Erding tests, aA Fairchild/Dornier DU328 was tested along with 10 GFMDs, including four SARSYS devices from Düsseldorf Airport, Frankfort Airport, Munich Airport, and Strate WHD Technik; two BV-11s from Vienna and Zurich Airports; an Airport Surface Friction Tester (ASFT); a Surface Friction Tester owned by Transport Canada (SFT-TC79); and an Instrument de Mesure Automatique de Glissance (IMAG).

In 2002 a two-week test session was held in North Bay, Ontario (January 28 to February 8), and a second session was held at Prague Airport, Czech Republic (March 4 to 8). In North Bay, ERD and IRV comparison tests were made as well as IRFI validation runs with seven GFMDs. During the second week in North Bay, a Cessna 414 was there for testing, but conditions were such that limited data were collected. During the Prague tests there were no winter conditions; therefore, wet tests were conducted to measure reproducibility and repeatability. In total there were 11 GFMDs (2 ASFTs, 4 SARSYSs, 2 SFTs, TATRA, Runway Friction Tester (RFT) and IRV).

Five years of NASA Aircraft Tire/Runway Friction Workshop data (1998-2002) have been combined with data from 19 weeks of winter testing in North Bay, Ontario (1996-2001), one week at Sawyer Airbase in Gwinn, Michigan (1999), two weeks in Oslo, Norway (1998-99), one week at Germany's Munich Airport (2000), one week at Erding Air Force Base in Germany, and one week at Prague Airport, Czech Republic.

Since the beginning of the JWRFMP in January 1996, 10 aircraft and 42 different GFMDs have collected friction data in North Bay, Ontario; at Sawyer Airbase in Gwinn, Michigan; at NASA Wallops Flight Facility, Virginia; in Oslo, Norway; in Munich, Germany; and at Erding Air Force Base, Germany. Over 450 aircraft runs and over 15,000 GFMD runs (over 41,000 data points) were conducted on nearly 40 different runway conditions. More than 300 individuals from nearly 50 organizations in 12 different countries have participated with personnel, equipment, facilities and data reduction/analysis techniques. CRFI and IRFI are two major outcomes from these efforts to harmonize ground vehicle friction measurements and to identify the relationship to aircraft stopping performance. Two international aviation conferences have been held in Montreal (October 1996 and November 1999) to disseminate the test results and obtain recommendations for future testing. Data from the seven annual NASA Tire/Runway Friction Workshops have been successfully completed to add dry and wet surface ground vehicle friction data to the database. Efforts were initiated in 2000 not only to get funding support from the European Union but also to get expanded support from the aircraft manufacturers and the airlines. Dialogue to obtain assistance from ICAO, ALPA and ACI will continue.

A substantial friction database has been established, with both ground vehicle and aircraft winter friction measurements. For each friction value, the database provides the name/type of device, test location, speed, tire specifications, surface conditions and ambient weather conditions. Table 1 is a list of all of the test aircraft that have been used in JWRFMP. Table 2 is a list of the GFMDs that have tested in JWRFMP and made sufficient runs with aircraft to allow correlations with the aircraft.

Table 1. List of JWRFMP Test Aircraft, 1996 to 2001

AIRCRAFT TYPE	OWNER/OPERATOR	MANUFACTURER
Falcon-20	National Research Council Canada	Dassault Aircraft Company
B-737-100	NASA Langley Research Center	Boeing Commercial Airplane Group
B-727-100	FAA Technical Center	Boeing Commercial Airplane Group
Dash-8	DeHavilland Aircraft Company	DeHavilland Aircraft Company
Dash-8	NAV CANADA	DeHavilland Aircraft Company
B757-200	NASA Langley Research Center	Boeing Commercial Airplane Group
A320	Aero Lloyd	Airbus Industrie
A320	Sabena Airline	Airbus Industrie
B-737-300	Deutsche British Airways	Boeing Commercial Airplane Group
DU 325	Dornier	Fairchild/Dornier

Table 2. GFMDs that Were Tested in the JWRFMP and Made Sufficient Correlation Runs with Aircraft, 1996 to 2001

Owner	Device Name	Manufacturer
TC	ERD mounted in Chevrolet Blazer	Transport Canada, Canada
TC	ERD mounted in Nissan Van	Transport Canada, Canada
TC	ERD mounted in truck Staff23 North Bay	Transport Canada, Canada
DGAC	IMAG Trailer	S.T.B.A Airports, France
NASA Langley Research Center	Instrumented Tire Test Vehicle (ITTV)	NASA Langley Research Center, USA
DGAC	IRV Trailer	S.T.B.A Airports, France
Ministry of Transportation, Ontario	Norsemeter ROAR Trailer	Norsemeter AS, Norway
Avinor	RUNAR Prototype Trailer	Norsemeter AS, Norway
FAA Technical Center	RFT	Dynatest, Inc., USA
FAA Technical Center	SFT	SAAB GM, Sweden
TC	SFT 1979 Ser #99	SAAB GM, Sweden
TC	SFT 1985	SAAB GM, Sweden
TC	SFT 1985 Turbo	SAAB GM, Sweden
Department of National Defence	GripTester	Indley Irvine, Ltd.

At all test sites, NRC provided ice and snow specialists who classified the winter contaminant. Typically, the water content, density, air and surface temperature, and depth of the contaminant were measured. Observations on the tire tracks produced by the test aircraft and ground vehicles were recorded. Hourly flight weather data were also recorded.

4.0 ESSENTIAL ELEMENTS OF THE STATISTICAL HARMONIZATION METHOD FOR IRFI

Normally, regression techniques would be used to find relationships between the reported friction values for pairs of GFMDs. One GFMD, or an algebraic transformation of reported friction values, such as the average friction of two or more GFMDs, would be selected as a reference. All GFMDs would then be compared with the reference device to establish transformation constants. The model assumed that when the interaction of one GFMD with one surface changed, all other similar tire-surface interactions would change in a similar way under the same conditions.

The statistical model provides good correlations with reasonable standard errors for bare ice and bare compacted snow surfaces, with the advantage that it is not necessary to identify the exact class of snow or ice contaminating the surface. For bare dry pavement and bare wet pavement, another set of correlations must be used. In addition, texture information or speed gradient is needed in the correlation equation for bare dry and bare wet pavement. For bare wet pavement, use of the International Friction Index (IFI) as specified in ASTM Standard E 1960 is recommended.

The field test data sampling for the model includes both ice and snow surfaces in order to create a data set of sufficient range to enable linear regressions.

A simple linear regression, called the statistical IRFI, is seen as a first step or an interim method that can be applied by the aviation community now. This model is a linear regression of the data for each device to a (virtual) IRFI reference:

$$\text{IRFI} = a + b \times \text{device friction measurement} \qquad (1)$$

where a is the intercept and b is the gradient, and where these constants were determined by regression with the reference device. Past attempts failed because the data used were not collected at the same time in the same wheel track. In 1998, the data were collected more systematically: pairs of GFMDs made each run consecutively, in a wave, so that they measured the same surface within about 15 seconds of each other. Previous data were not collected in this manner, and it was found that the surface characteristics could change so quickly that the different measurement devices had actually tested different surfaces and so the regression analysis was less exact.

This change in time is critical when regressions are being made, but once the regression constants have been determined, their use in calculating IRFI during operating conditions is not time critical.

4.1 IRFI Reference Selection

A true value is needed in order to perform a linear regression; therefore, a virtual GFMD, called the reference, was developed from combinations of GFMDs for 1998 and 1999. Based on a review [2, 3], it was concluded that the best option for the reference was to use the average of the SFT-TC79 and the IMAG. However the SFT-TC79's instrumentation was updated in 1999, making it appear as another device, and the virtual device reference was dropped. In late 1999, STBA offered a second and dedicated IMAG to JWRFMP and it was accepted and designated as the IRV for JWRFMP. The IRV is now dedicated to the project and not used for any other purpose. A separate study was performed to relate the IMAG used in 1998, 1999 and 2000 to the IRV [6]. This study concluded that the IRV = 0.95 * IMAG. Thus the reference now used for calibration is IRV or 0.95*IMAG, if IRV data are not available.

4.2 IRFI Correlations

The seven tables in Appendix A give the IRFI correlation constants *a* and *b* for each year from 1996 to 2002. However, the 1996 and 1997 values came from a reference of 0.95 IMAG Torque. Between 1997 and 1998 the IMAG was modified and thus was considered a different device. The 1996-97 correlations were therefore generally discarded. Table 3 is a summary of the harmonizing values of all GFMDs from 1998 to 2002.

Table 3. Summary of Harmonizing Values

Year	*a* Min.	*a* Max.	*a* Ave.	*b* Min.	*b* Max.	*b* Ave.	St. Error
1998	-.05	.08	.03	.7	1.01	.82	.04
1999	0	.17	.09	.21	1.14	.67	.04
2000	.04	.25	.15	.28	.99	.62	.07
2001	.02	.21	.09	.61	.93	.74	.07
2002	.01	.19	.1	.52	.85	.68	.05

4.3 Errors of Fitted IRFI Values

Also given in the seven tables in Appendix A are the correlation R^2 and the standard error of estimate for each of the years. In 1998 the R^2 ranged from 0.45 to 0.99 with an average of 0.86; in 1999 the R^2 ranged from 0.05 to 0.74 with an average of 0.46; in 2000 the R^2 ranged from 0.10 to 0.99 with an average of 0.62; in 2001 the R^2 ranged from 0.41 to 0.98 with an average of 0.83; and in 2002 the R^2 ranged from 0.42 to 0.94 with an average of 0.80.

In looking at these values, it appears the correlations were not as good in 1999 and 2000 as in other years. On the average this is true for several reasons. In 1998 extra care was exercised in a number of the field tests to ensure no loose snow was present on the bare compacted snow and bare ice surfaces. In 1999 the tests included tests in deep snow, and more tests were conducted with some loose snow on the ice and packed snow, making the sites more variable and subject to the test location of each run. In 2000 tests were conducted under very poor conditions due to lack of snow, and the test beds were very variable. This shows the need for good test conditions to maintain the best accuracy when collecting correlation data.

It should also be noted that GFMDs tested at all sites generally had better R^2 and a better standard error of estimate than those just tested in Europe. Even so, the average standard error of estimate was less than 0.05, and more than half of the GFMDs were lower. This is in comparison to as much as 0.2 without the IRFI harmonization applied.

4.4 Errors of Predicting IRFI Values

Due to the natural scatter in friction values typically obtained on a runway surface, the predicted IRFI value will show a similar scatter when harmonization is applied to individual reported friction values by a local airport GFMD. The harmonization method is not designed to moderate any surface variability or take into account local runway variability.

The pairs of data samples collected to determine a harmonization equation have variability about the fitted equation line, often expressed in standard deviation. The prediction interval for a given confidence level is proportional to this standard deviation. In other words, the range in error when calculating IRFI values for a harmonized GFMD is a characteristic of the original paired data collection for the determination of the harmonization equation.

It is therefore not possible to calculate what errors the IRFI values would have at a local airport runway that was not part of the original paired data collection.

One may, however, venture to state that, provided the harmonization paired data collection has a sufficient range of friction levels and surface textures and includes representative operational runway characteristics, the error would be within the bounds of the harmonization data set variability. This variability is largely surface variability. Such bounds have been found typically in JWRFMP data sets to be in the order of +/- 0.10 friction units for a 95% confidence level, i.e., 19 of 20 calculations will be within an error of 0.10 friction value. Most of this error is due to surface variability. One may therefore argue that these bounds are not relevant for the friction values of harmonization transforms, since they largely stem from surface variability. The fitted harmonization transform is a product of averaging out much of the surface variability to find the quantitative relationship between two GFMDs.

4.5 Limitations Of and How to Improve the Statistical IRFI

No correlations can be expected to remain stable with time since certain variables are subject to change (e.g., the devices change, new tires are installed, equipment is subjected to wear). Thus, there is a need to have periodic correlations to maintain accuracy.

IRFI has initially been studied as a common unit of friction measure. When bringing the IRFI transforms into practical use at airports that have different sampling techniques of their runways, it must be expected that the practical implementations will diverge in reported IRFI values. Notably, continuous friction measuring devices sample contaminated and non-contaminated sections of a runway and include these sections in the harmonization. A spot measuring device may collect only selected contaminated sections of the runway. IRFI was not designed to overcome differences in sampling techniques.

The exercise performed with a chosen reference demonstrates that harmonization can be achieved with a statistical model. The issue of making available a permanent reference device for the airport industry was solved with the donation of the IRV by STBA. However, there is still a need to evaluate the reference device to aircraft. Based on this evaluation, there may still be a need to design and build a special reference device. With this in mind, ASTM Committee E17 has formed a working group to address this possibility.

5.0 STABILITY OF THE HARMONIZATION METHOD

5.1 Reproducibility Concerns

When several GFMDs of the same standard type are brought together to measure the same surface condition, the degree to which they report the same value of friction is called reproducibility. Any differences in reported friction values across the devices can be expressed in terms of standard deviation or standard error relative to the arithmetic means of all the measures from all GFMDs studied.

Recent and unique studies performed by NATAM (now Avinor) as described in [7-10] demonstrated that reproducibility of two different kinds of continuous friction measuring devices were 0.05 friction units for both kinds operated at 65 km/h. This was achieved when the devices were in a technical state as normally used at Norwegian airports. Every effort was made to operate the devices under equal conditions during the field testing. The studies included 25 and 15 units, respectively, of standard GripTesters and non-standard BV11's configured with ASTM smooth measuring tires. The measurements were made under self-wet conditions on a total of 32 surface segments of 100 m each, made of 8 different asphalt mixtures. The macrotexture of these surfaces ranged from 24 km/h to more than 260 km/h in IFI speed numbers, corresponding to 0.3 – 2.5 mm mean texture depth as measured by the sand patch method according to ASTM E 965. The friction values were averages of three runs across each segment by each device.

After thorough machine part inspections, replacements of out-of-tolerance worn parts, instrumentation calibration by the manufacturer, and fitting of new measuring tires, the reproducibility of the GripTesters was improved from 0.05 to 0.03 friction units in terms of standard deviation.

It is believed that a significant part of the 0.03 value of reproducibility stems from surface and field test variability. The GFMDs were not measuring exactly the same tracks and had different host vehicles and drivers. The self-wet systems had no feedback control of the water flow. However, the figure should be taken as an indication of what the reproducibility in terms of standard deviation can be at its best for a cross section of asphalt surfaces. It may be more prudent in many evaluations to use the original 0.05 figure as representative of operational equipment states, when equipment is partly worn and are fitted with partly worn measuring tires.

5.2 Time Stability of Individual GFMDs

In order to evaluate the time stability of individual GFMDs, a year-by-year comparison of the IRFI constants in JWRFMP was made. Appendix A gives the values of the IRFI constants *a* and *b* for each year from 1998 to 2002. In addition, the regression R^2, standard error, number of data points and some comments are given for each GFMD. The year-by-year regressions also show that the same types of GFMDs can produce very different results that require different IRFI regression constants. The tables in Appendix A clearly show that not only are there differences within a class of GFMDs, but that an individual device changes from year to year. Based on the findings from the research of 2000, the ASTM standard was modified to require at least annual determination of the IRFI harmonization coefficients.

6.0 IRFI CORRELATIONS WITH AIRCRAFT BRAKING PERFORMANCE

6.1 Conditions for Data Used for Correlations

This analysis converts GFMD to IRFI [11] using the harmonization constants *a* and *b*, and plot the aircraft braking coefficients of friction, Mu, against IRFI for some or all of the 275 aircraft test points [12]. The results are compared to aircraft Mu plotted against IRV and 0.95*IMAG when IRV data are not available. The correlation constants with aircraft to GFMD are called “zero intercept” and “slope multiplier” to distinguish them from the correlations for IRFI calibration of GFMD to the reference (IRV), which are called *a* and *b*. Values of harmonization constants *a* and *b* as determined during each year of testing were used. Appendix A gives the correlations from the database from 1996 to 2002. When IRV did not run, 0.95 IMAG is reported. It should be noted that IMAG reported only torque in 1996 and 1997 and was overhauled and improved between 1997 and 1998. In addition, when torque is measured, the drag is not measured. Since there was a lot of drag in the 1996 and 1997 tests, IMAG must be considered a different device after 1997 and therefore, 1996 and 1997 correlations should be avoided and are not generally used. Also, in a few cases, the correlation gives a negative zero intercept that is caused by the statistics. Physically this cannot be negative. Since the negative values are always very small, it is recommended that when this happens, zero intercept should be applied when applying IRFI.

IRFI was investigated for the following GFMDs: ERD Blazer, IMAG, ITTV, RUNAR, FAA RFT, SFT212, SFT99, SFT79, and SFT85. Other GFMDs were excluded because they did not have many runs with aircraft. Correlations of GFMDs with three or fewer runs with aircraft were not used. The GFMDs not used are:

GFMD Cut	Runs
ASFT-801-E1551-30	1
ASFT-801-UNIT-100	2
BV11-VIE-T520-100	3
BV11-ZUR-T49-20	3
GRT-DND-E1844-20	3
GRT-DND-STD	1
SAR-527-AERO-100	1
SAR-527-E1551-30	2
SAR-813-E1551-30	2
SAR-814-TRBL-30	2
SFT-99-AERO-100	2

Correlations of the other GFMDs are given in Appendix B. The GFMDs that had only a few runs are not shown in the report. Also, the ITTV is only given in the appendix since it gave a very poor correlation due to the many mechanical problems it had.

The following surface conditions are examples of those <u>not</u> considered uniform and are not included in the analysis when the figure shows "non-uniform sited removed" (specific surfaces are shown in Appendix C):

- Bare and wet/damp (spot measurements only);
- Over one inch of granular snow with unnaturally high specific gravity (over 0.5);
- Snow referred to as "medium compact" for GFMDs, but ending up as "loose snow" for the aircraft;
- Variable surface conditions, such as 60% bare and dry, 30% loose snow or ice patches;
- Surfaces with more than 20% slush;
- Outliers that are more than two standard deviations.

Appendix B gives IRFI correlations for each test site and year.

All test points are listed in Appendix C. The various columns are:

Column	Name	Description
A	GFMD	Device name
B	A/C	Aircraft type
C	Date	Date of test
D	Type	Force or torque device
E	G_T&F	GFMD friction measurement
F	A/C-Mu	Aircraft Braking Friction
G	IRFI(GFMD)	IRFI of GFMD in column E using *a* and *b* from IRFI calibration in Appendix A
H	A/C-Mu	Same as L
I	Uniform*	Uniform site? OK or NO
J	Cut Points*	Outliers? OK or YES

*Explanation given above

6.2 Analysis

6.2.1 International Reference Vehicle (IRV)

Figure 1 gives the aircraft versus IRV or 0.95 times IMAG correlation with all data points. For the reasons stated in section 6.1, 1996 and 1997 data are then removed and the correlation is redone as shown in Figure 2. This increases the R^2 from 0.60 to 0.70, increases the slope multiplier and decreases the zero intercept. Finally, Figure 3 shows the same analysis with some obvious outliers removed, and as expected, this increased R^2 to 0.86. The results from Figure 2 are then used as the reference to compare results with the other GFMDs. Data are mostly in two clusters, which is true of winter surfaces. It is recommended that more data in the 0.45 to 0.65 range be collected where feasible.

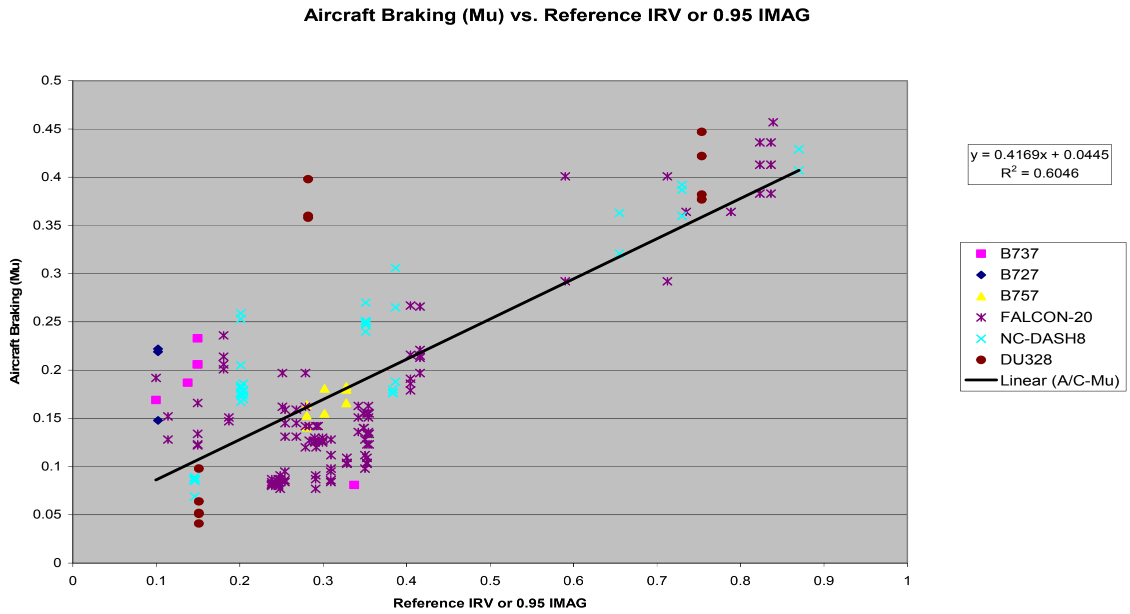

Figure 1. Aircraft Braking versus IRV or 0.95 IMAG Measurements

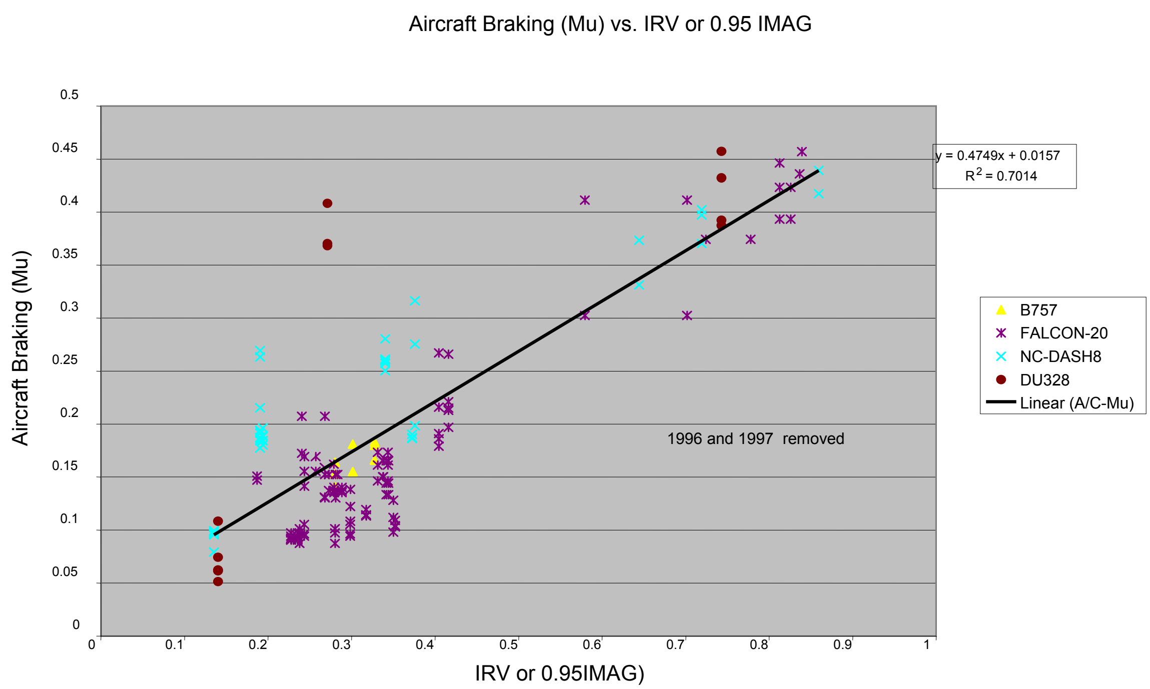

Figure 2. Aircraft Braking versus IRV or 0.95 IMAG Measurements with 1996 and 1997 Removed

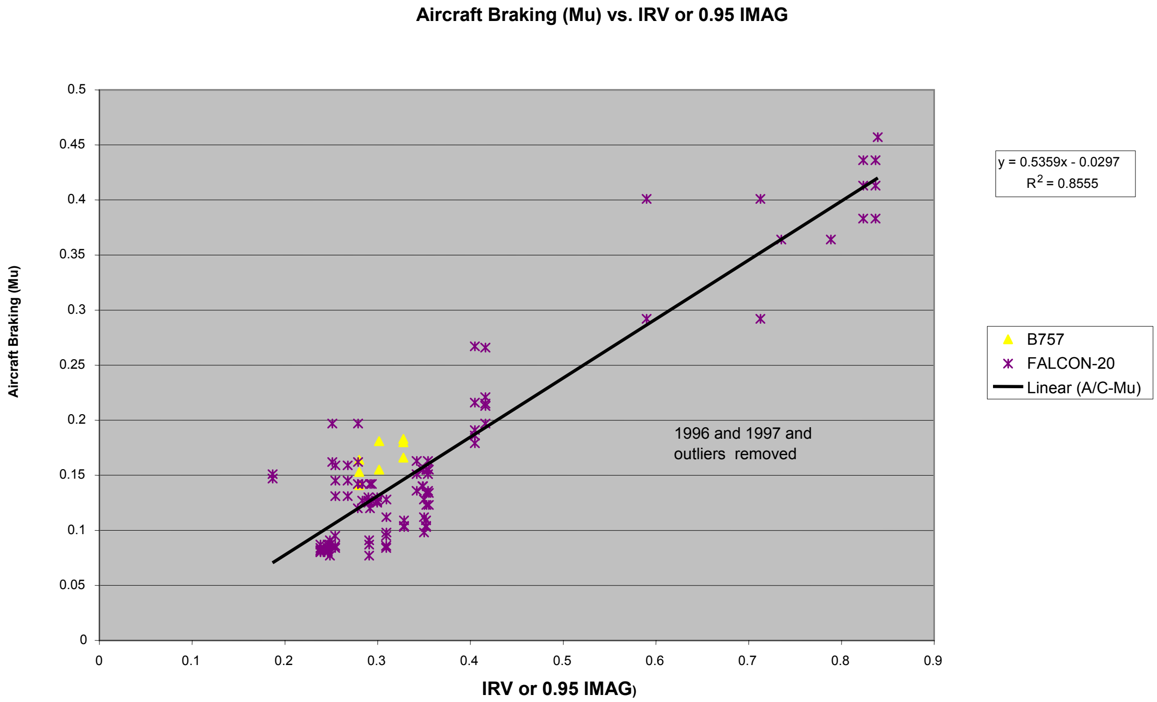

Figure 3. Aircraft Braking versus IRV or 0.95 IMAG Measurements with 1996 and 1997 and Outliers Removed

6.2.2 Electronic Recording Decelerometer (ERD)

Several analyses were done and are plotted in Appendix B. Both ERD-Blazer and ERD-23 are used in the analysis because many runs were made with just the ERD-23 and the Falcon 20 while the ERD-Blazer was being used in Europe for a year.

In Appendix B, Figure B1A shows the correlation with all aircraft points. Figure B1B shows the correlation with 1996 and 1997 data removed. Figure 4a in this report shows the correlation of the ERD with aircraft with no correction and Figure 4b shows the correlation after IRFI is applied.

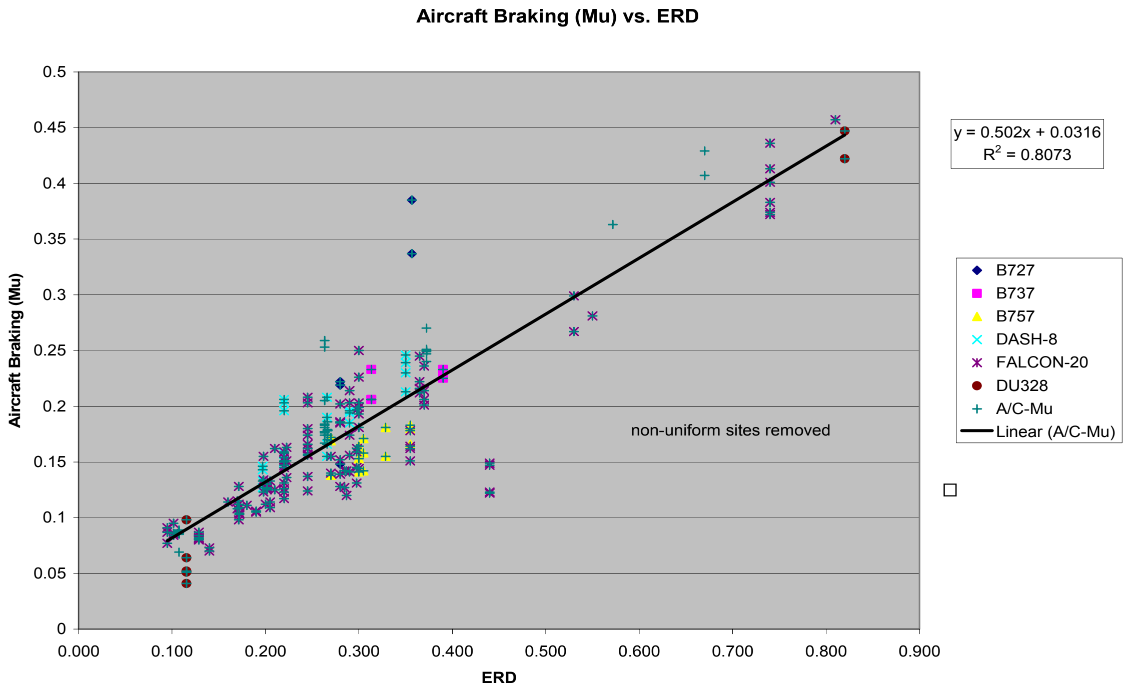

Figure 4a. Aircraft Braking versus ERD Measurements with Non-uniform Sites Rremoved

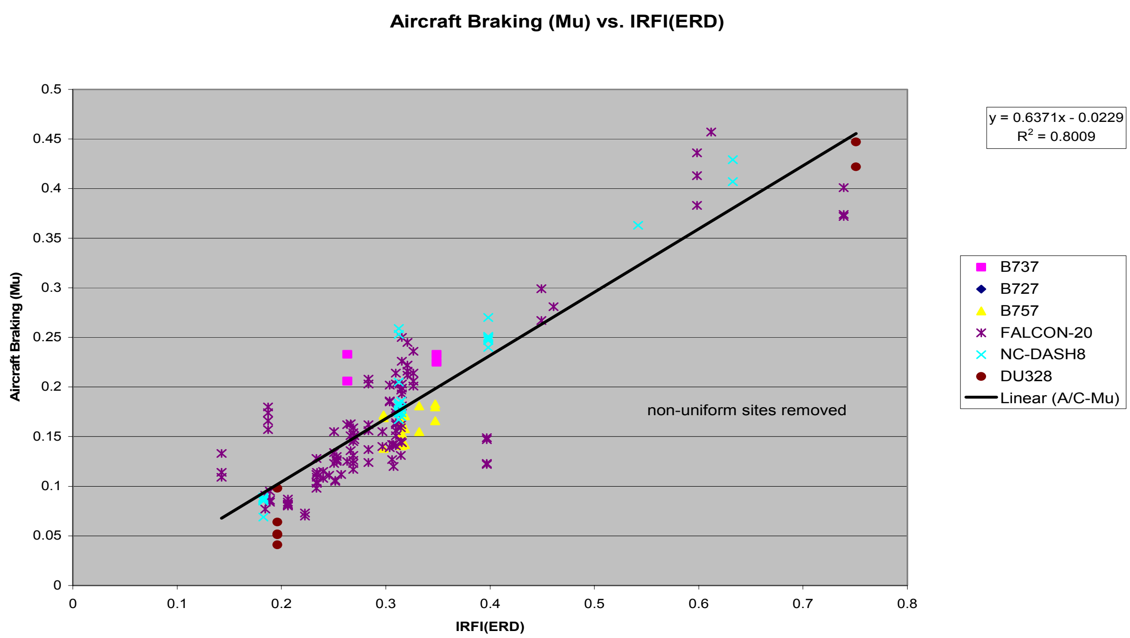

Figure 4b. Aircraft Braking versus IRFI(ERD) with Non-uniform Sites Removed

6.2.3 IMAG

Figures 5a and 5b show the IMAG correlations to aircraft without and with IRFI applied. In both cases the 1996 and 1997 data are removed.

Aircraft Braking (Mu) vs. IMAG

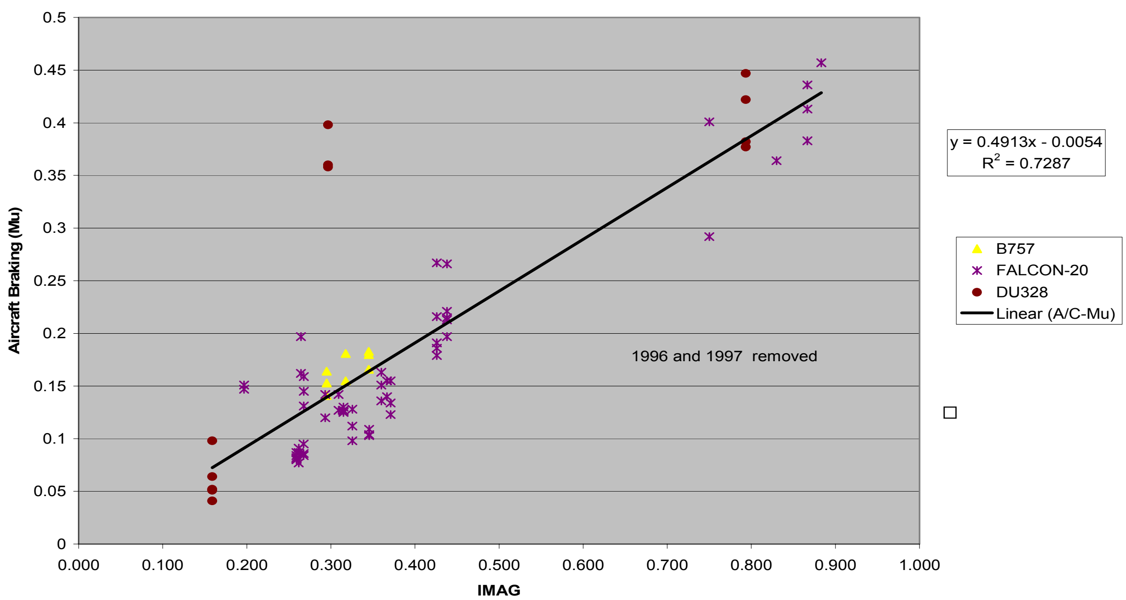

Figure 5a. Aircraft Braking versus IMAG Force Measurements with 1996 and 1997 Removed

Aircraft Braking (Mu) vs. IRFI(IMAG)

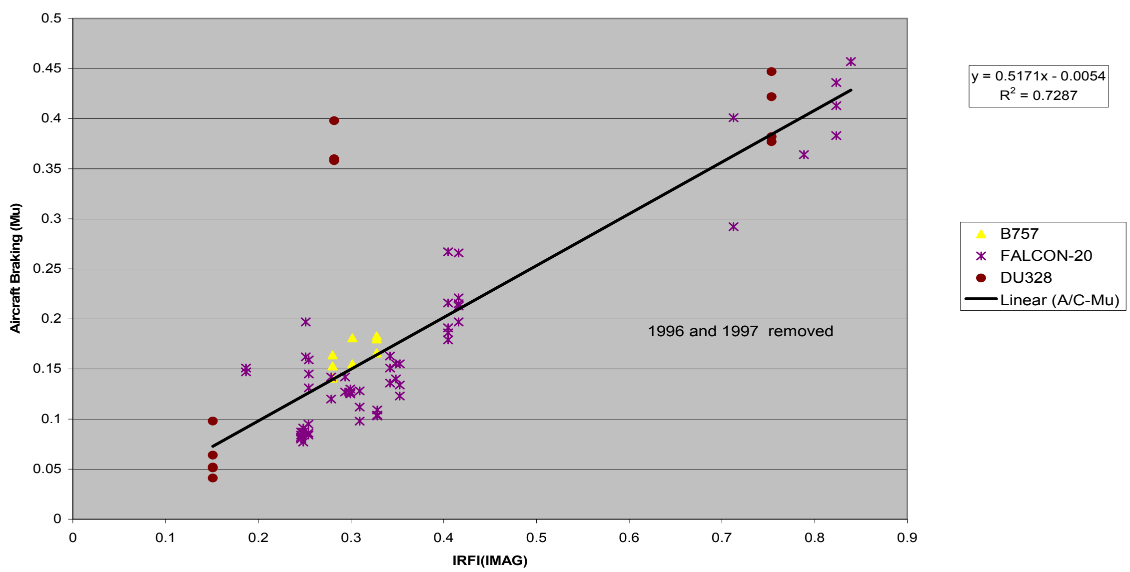

Figure 5b. Aircraft Braking versus IRFI(IMAG) with 1997 and 1997 Removed

6.2.4 Other Ground Friction Measuring Devices (GFMD)

All other correlations of the aircraft with GFMD are given in Figures 6a through 10b, first without IRFI applied and then with IRFI applied. The R^2's vary from a low of 0.50 up to 0.88. Figures 6a and 6b are for RUNAR; Figures 7a and 7b are for the GripTester (GT-DND); Figures 8a and 8b are for the Runway Friction Tester (RFT); and Figures 9a through 10b are for Surface Friction Testers (SFT79 and SFT85). Correlations for SFT212, SFT99, and SFT85 along with the ITTV are given in Appendix B. There are very few points for the SFT212, SFT99, and SFT85. As stated in section 6.1, the ITTV correlations have been discounted due to many mechanical problems that resulted in a correlation that must be considered an outlier.

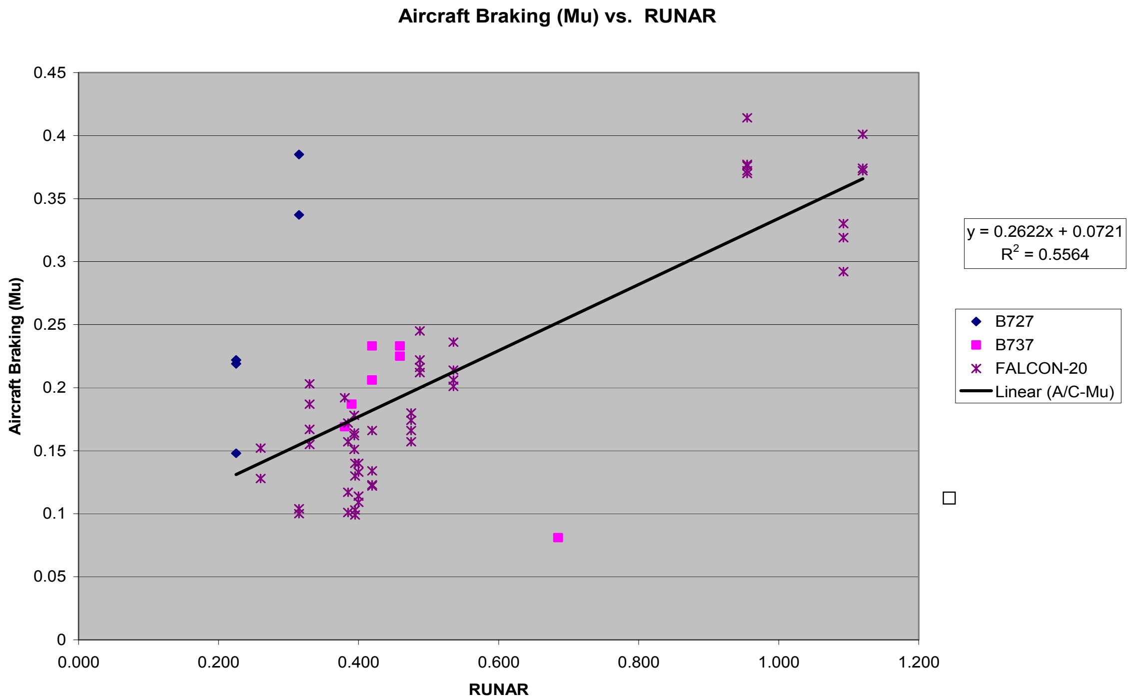

Figure 6a. Aircraft Braking versus RUNAR Measurements

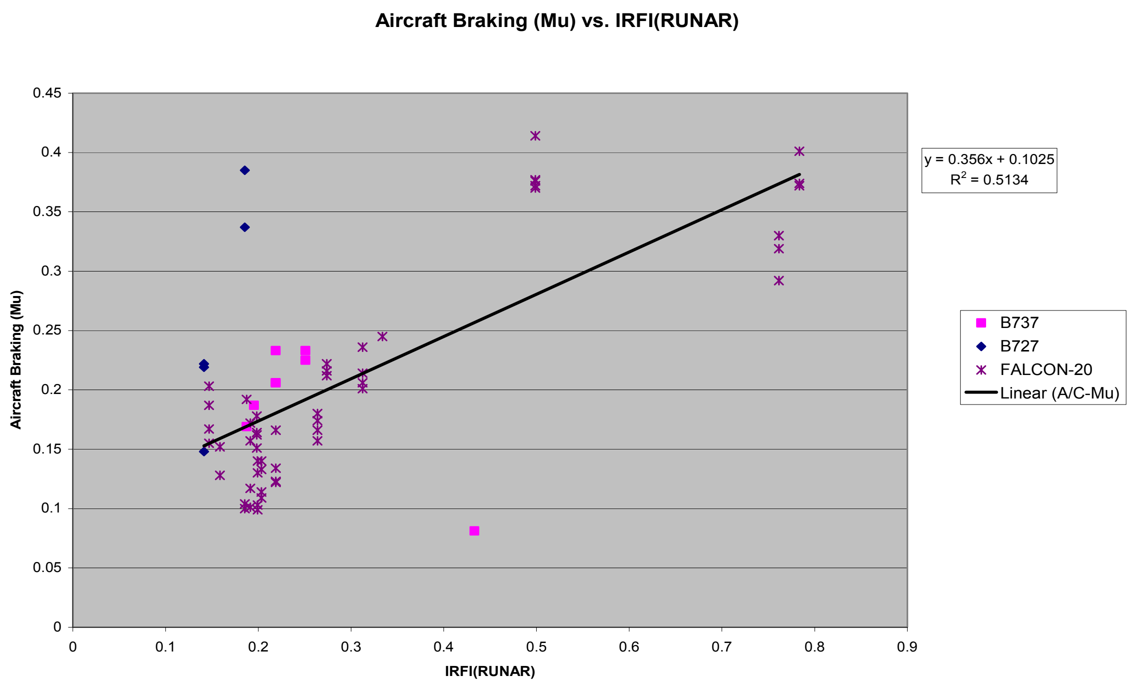

Figure 6b. Aircraft Braking versus IRFI(RUNAR)

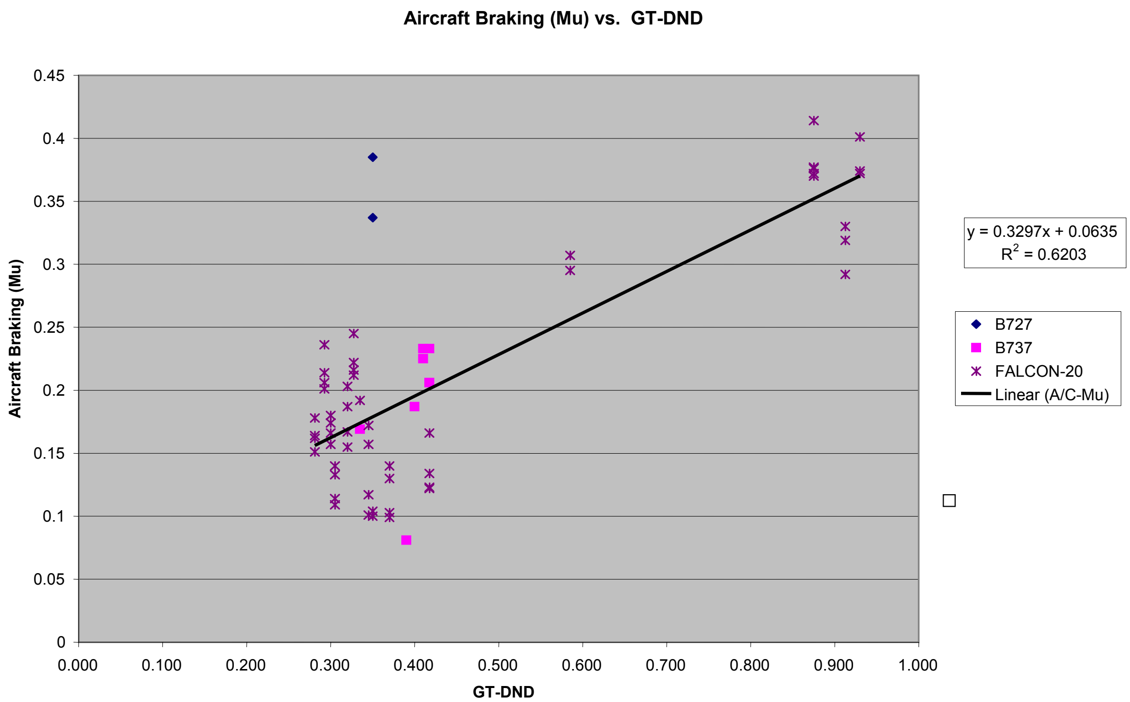

Figure 7a. Aircraft Braking versus GripTester-DND Measurements

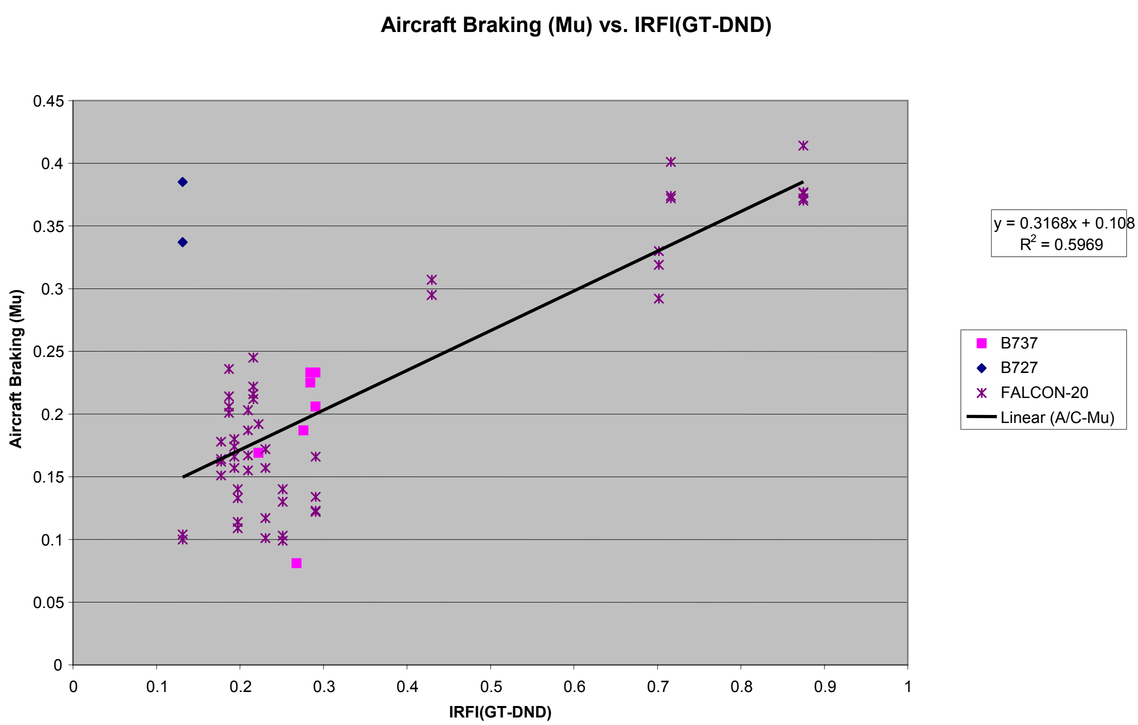

Figure 7b. Aircraft Braking versus IRFI(GripTester-DND)

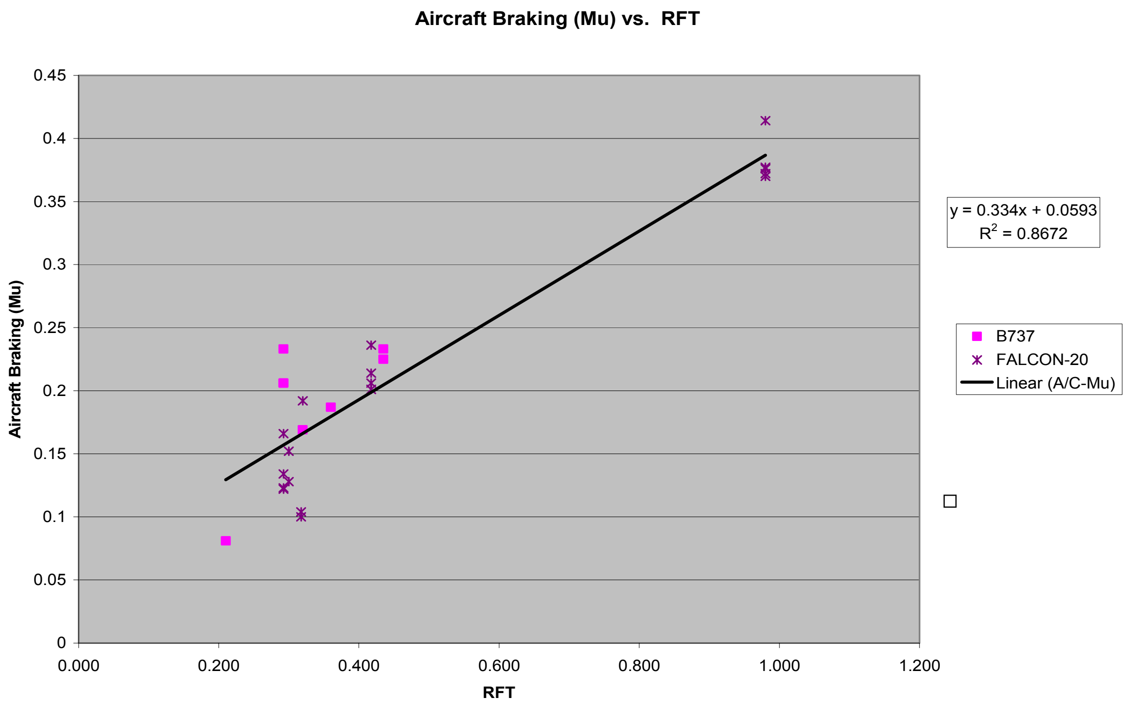

Figure 8a. Aircraft Braking versus RFT Measurements

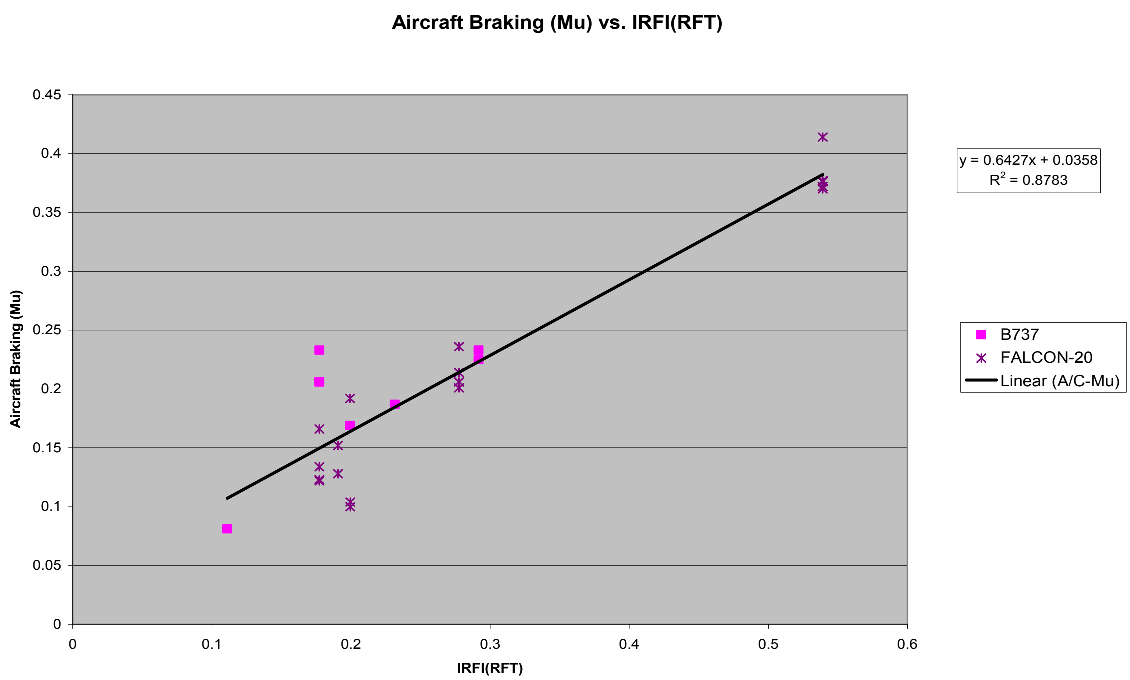

Figure 8b. Aircraft Braking versus IRFI(RFT)

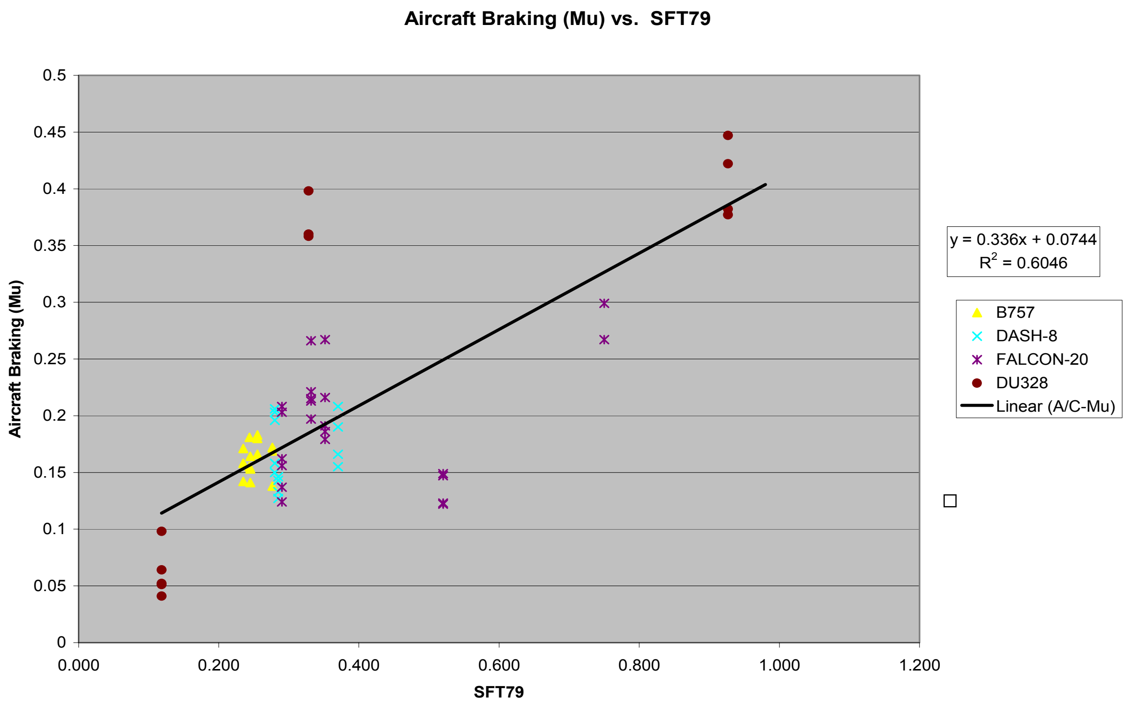

Figure 9a. Aircraft Braking versus SFT79 Measurements

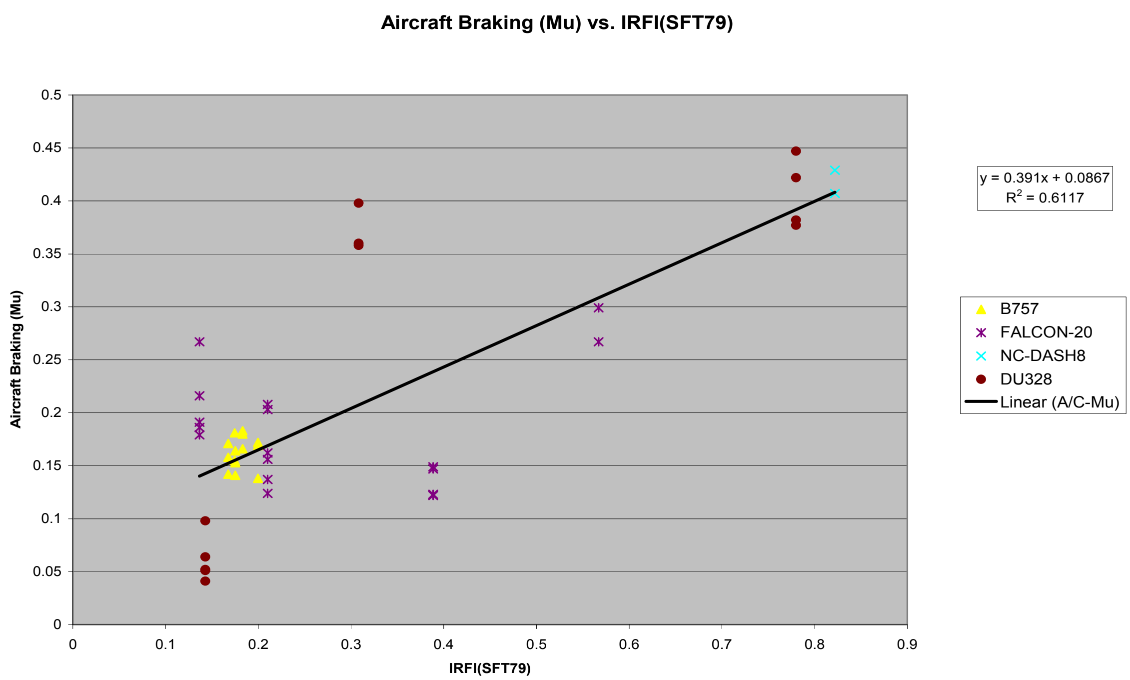

Figure 9b. Aircraft Braking versus IRFI(SFT79)

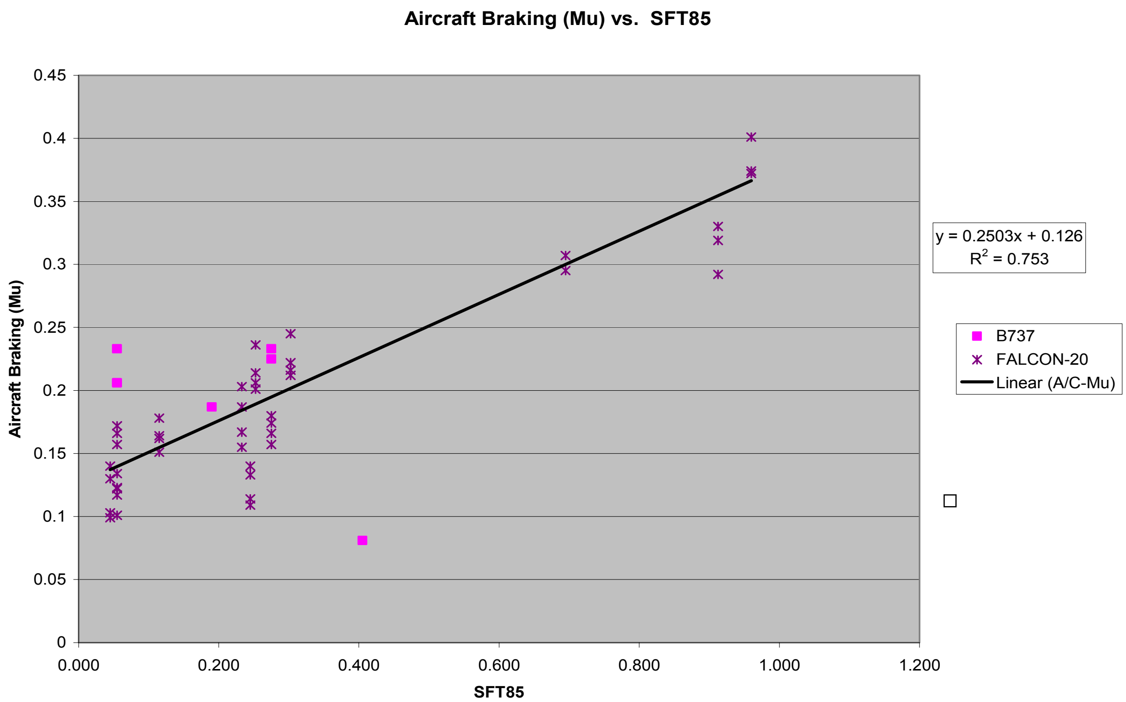

Figure 10a. Aircraft Braking versus SFT85 Measurements

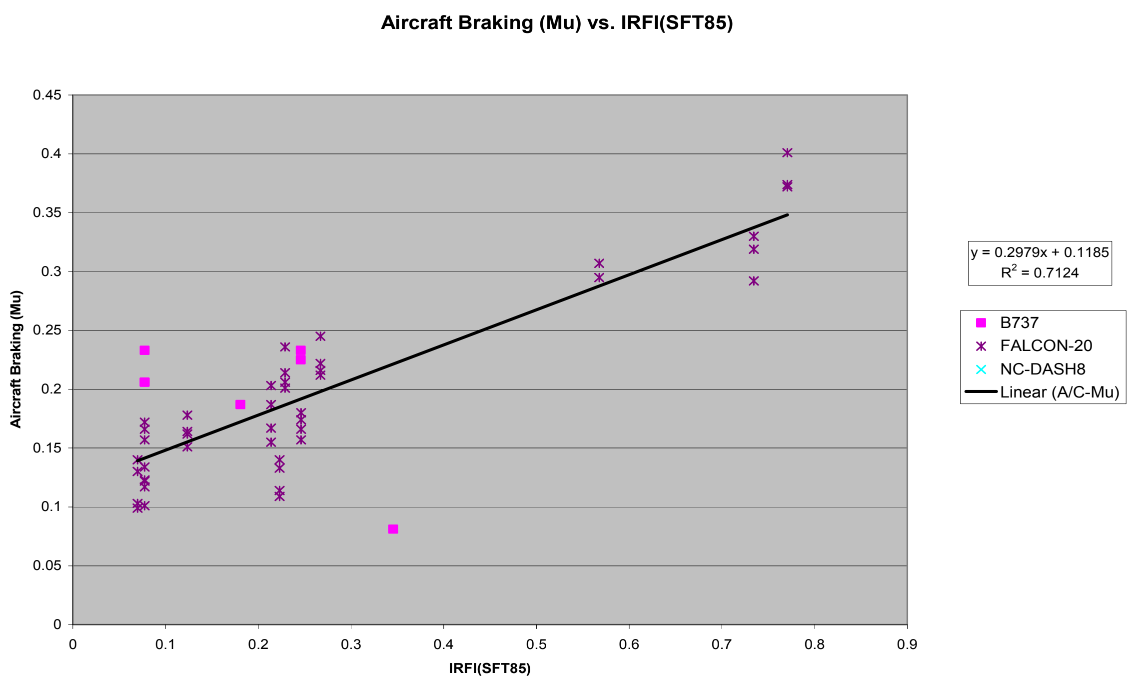

Figure 10b. Aircraft Braking versus IRFI(SFT85)

6.2.5 Summary of Analysis

In summary, Table 4 compares the zero intercepts and slope multiplier values of the GFMDs before and after IRFI is applied.

Table 4. Summary of Aircraft Correlations

	Device			IRFI(Device)		
Device	Zero Intercept	Slope Multiplier	R^2	Zero Intercept	Slope Multiplier	R^2
Reference	0.016	0.48	0.7	0.016	0.48	0.7
ERD	0.03	0.5	0.81	-0.023	0.64	0.8
IMAG	-0.005	0.49	0.73	-0.005	0.52	0.73
RUNAR	0.07	0.26	0.56	0.103	0.36	0.51
GT-DND	0.064	0.33	0.62	0.108	0.32	0.6
RFT	0.06	0.33	0.87	0.04	0.64	0.88
SFT79	0.07	0.34	0.6	0.08	0.39	0.61
SFT85	0.126	0.25	0.75	0.119	0.3	0.71
SFT212	0.178	0.23	0.52	0.13	0.37	0.89
SFT99	0.08	0.37	0.81	0.13	0.54	0.94

Table 4 clearly shows that:

a) the correlation (R^2) between aircraft Mu and device friction does not change much when converted to IRFI, meaning that the correlation depends on the device, not the IRFI conversion;
b) the four SFTs all have very high zero intercepts caused by their having problems measuring friction in significant depths of snow;
c) the devices with the best correlations, namely the ERD, IMAG, and RFT, are also the closest to the reference device for both zero intercept and slope multiplier.

To see how IRFI reduces the difference of each GFMD when compared to the reference, Figure 11 shows the slope multipliers versus the reference graphically. Ideally one would want all the IRFI values to approach the reference. Figure 12 shows the difference of the slope multipliers from the reference. The average error is 0.14 without IRFI and 0.05 with IRFI (absolute error of 0.1), or a 64 percent reduction in the error.

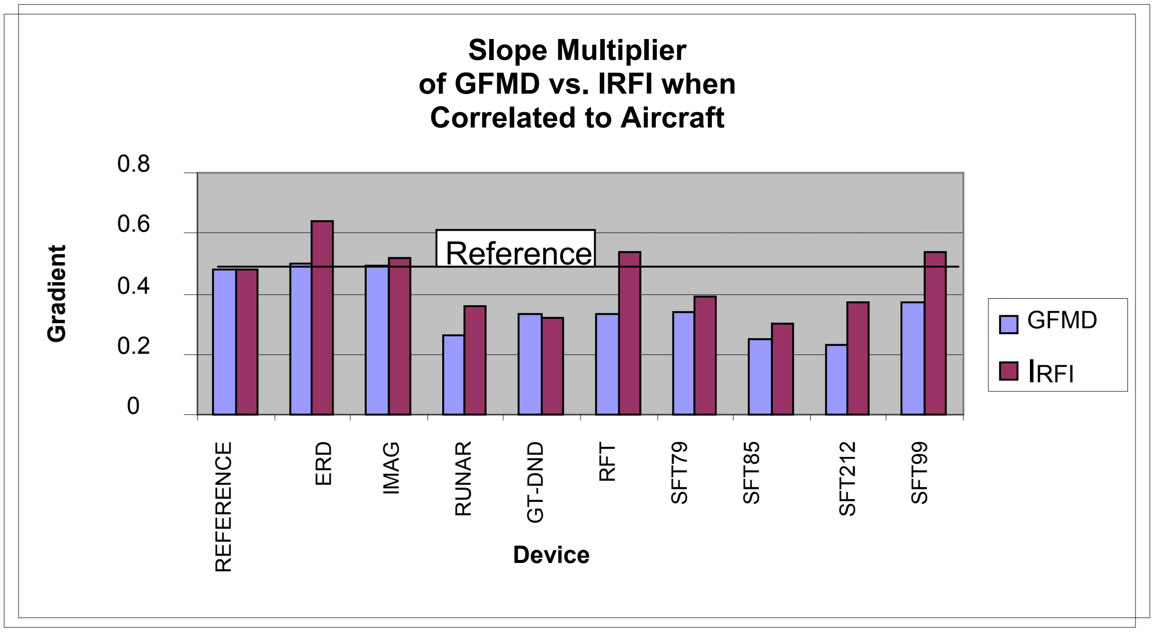

Figure 11. Slope Multpliers of GFMDs versus their IRFI Correlations to Aircraft

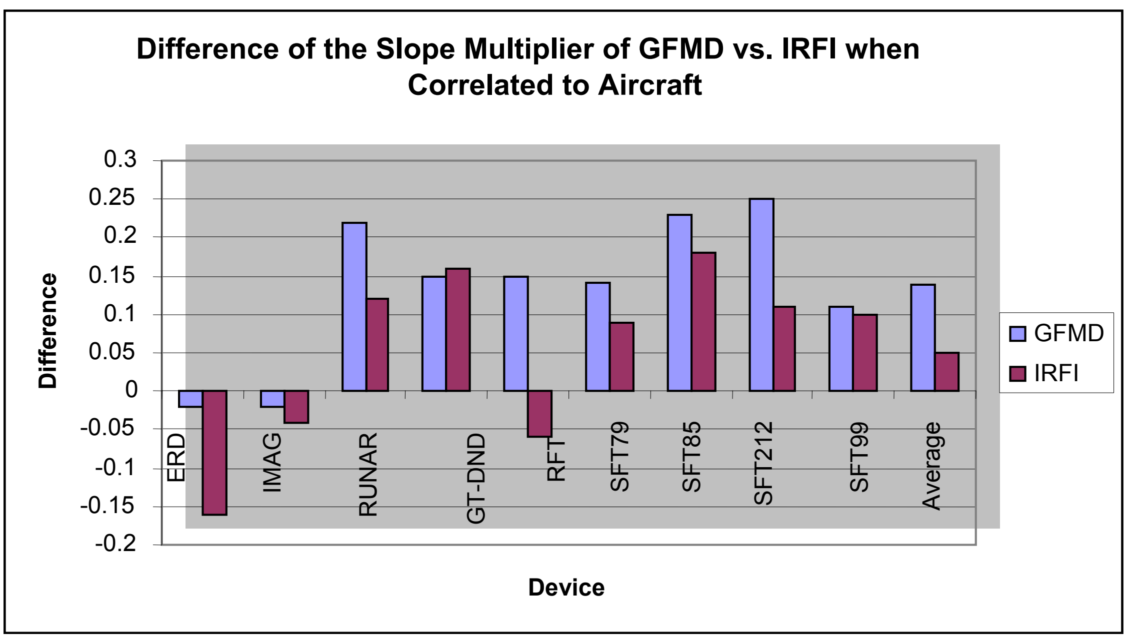

Figure 12. Error of the slope mutiplier of GFMDs versus their IRFI Correlations to Aircraft

Figure 13 shows the zero intercepts. The SFT99, 85 and 212 are omitted since they had very few points and their intercepts are outliers.

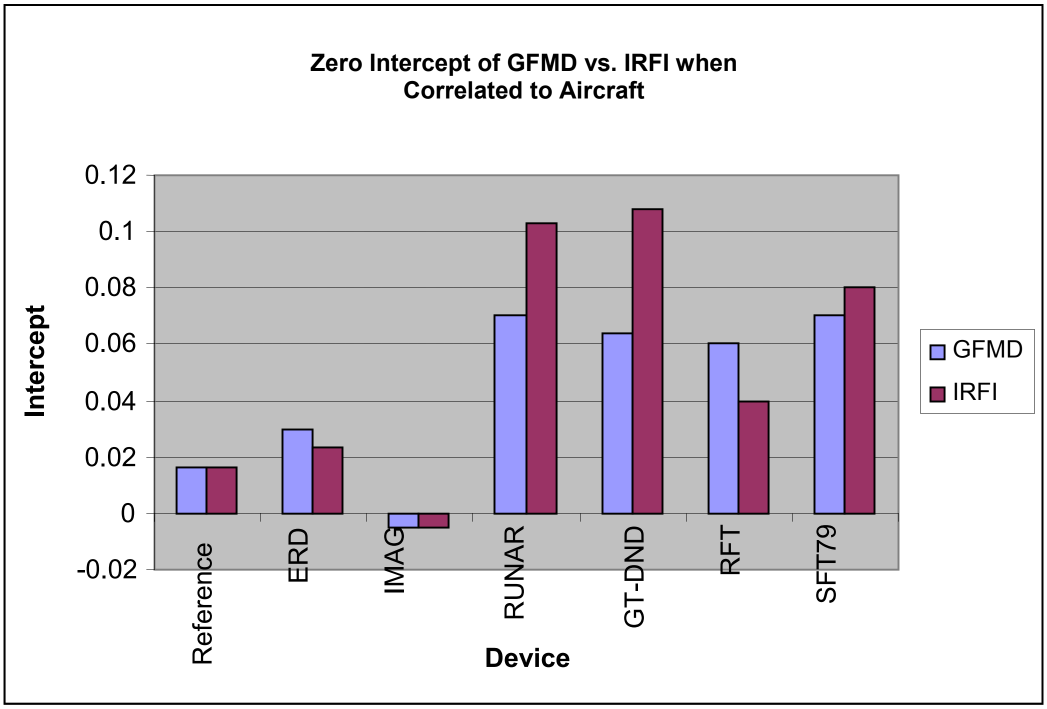

Figure 13. Zero Intercepts of GFMDs versus their IRFI Correlations to Aircraft

The zero intercepts shown are reasonable for the IRV, ERD, IMAG (slightly negative). The RFT and SFY79 are slightly higher and the RUNAR and GT-DND higher still. The SFT99, 85 and 212 are omitted since they had a very few points and their intercepts are outliers.

7.0 CONCLUSIONS AND RECOMMENDATIONS

ASTM Standard E 2100-00 defines and prescribes how to calculate IRFI for winter surfaces. IRFI is a standard reporting index to provide information on friction characteristics of the movement area to aircraft operators.

IRFI can be used by airport maintenance staff to monitor the winter frictional characteristics in support of surface maintenance actions. Since many aircraft tests were run on prepared surfaces, more actual operational runs should be included in future tests.

The IRFI method typically reduces the present variations among different ground friction measuring devices from 0.2 down to 0.05 friction units.

A reference device, which is required for calibration, must be a dedicated device for this purpose only, and the aviation community must agree on its provision, ownership and services. The device chosen for the exercises to demonstrate that IRFI is possible was an IMAG device called IRV. IRV must be evaluated at some point for stability. If it is not stable with time, other references would need to be investigated. All harmonization constants will have to be reworked when a permanent IRFI reference has been designated. It is recommended that a reference device:

- Measure both force and torque;
- Have a high footprint contact pressure, greater than 500 kPa;
- Have variable or adjustable slip ratios up to 100%;
- Have a standard tire that is reproducible from tire to tire;
- Be equipped with an anti-skid system; and
- Be a trailer device that is compact for shipping and can be towed with most any truck.

IRFI does help reduce the differences between GFMDs when correlated to aircraft. The average difference is 0.14 without IRFI and 0.05 with IRFI (absolute error of 0.1), or a 64% reduction in the difference. IRFI does not significantly affect the degree of correlation between the individual GFMDs and aircraft Mu as would be expected with a linear correlation. The project has shown that IRFI can be used to predict aircraft braking performance.

Their have been two International Meetings on Aircraft Performance on Contaminated Runways [13,14]. A third meeting is recommended to present the results of JWRFMP.

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APPENDIX A

Compilation of Yearly IRFI Constants, 1996-2002, by GFMD

Table A.1 1996 (Correlations to 0.95 IMAG Torque)

	a	*b*	R^2	StdError of Estimate	No of data points
ERD-BLAZER	-0.065	0.982	0.60	0.125	31
GT-TC-E1844-20	-0.024	0.714	0.69	0.100	75
RFT-FAA-E1551-30	-0.030	0.732	0.85	0.064	71
RUNAR-NATAM-E1551-V-30	-0.063	0.652	0.87	0.073	79
SFT-TC85-E1551-30	0.053	0.697	0.87	0.069	63
min	-0.065	0.652	0.60	0.064	31
ave	-0.026	0.755	0.78	0.086	64
max	0.053	0.982	0.87	0.125	79

Table A.2 1997 (Correlations to 0.95 IMAG Torque)

	a	*b*	R^2	StdError of Estimate	No of data points
ASFT-ASFT-AERO-100	-0.027	0.789	0.70	0.081	88
ERD-BLAZER	0.113	0.188	0.03	0.066	93
GRT-DND-STD	-0.019	0.617	0.41	0.070	247
GT-TC-E1844-20	0.149	-0.011	0.00	0.051	111
RFT-FAA-E1551-30	0.041	0.512	0.18	0.063	144
RUNAR-NATAM-E1551-V-30	0.050	0.450	0.41	0.069	243
SFT-212-E1551-30	0.049	0.567	0.59	0.041	113
SFT-99-AERO-100	0.032	0.606	0.61	0.059	202
SFT-TC79-E1551RIB-30	0.031	0.614	0.74	0.050	192
SFT-TC85-E1551-30	0.058	0.658	0.85	0.043	120
min	-0.027	-0.011	0.00	0.041	88
ave	0.048	0.499	0.45	0.059	155
max	0.149	0.789	0.85	0.081	247

Table A.3 IRFI Constants for 1998

Device tire configuration	*a*	*b*	R^2	StdError of Estimate	No of data points	Comment
ERD-NISSAN	0.03	0.90	0.45	0.076	176	Good plot
ERD-23	0.08	0.83	0.72	0.042	83	
ASFT-ASFT-AERO-100	-0.05	0.91	0.78	0.072	536	
BV11-OSL-T520-100	0.03	0.75	0.85	0.061	528	
GRT-NCAA-SLUSHCUT	0.03	0.78	0.88	0.044	635	Good plot
GRT-NCAA-E1844-20	0.01	0.89	0.91	0.035	360	Good plot
SFT-TC79-E1551-100	0.05	0.71	0.95	0.034	683	Very good plot
BV11-196-T520-100	0.01	0.82	0.96	0.036	154	Two data clusters
ITTV-NASA-AC26-136	0.08	1.01	0.96	0.037	141	
RFT-FAA-E1551-100	0.02	0.70	0.98	0.032	42	Two data clusters
SFT-212-E1551-100	0.02	0.74	0.99	0.023	42	Two data clusters
min	-0.05	0.70	0.45	0.02	42.00	
ave	0.03	0.82	0.86	0.04	307.27	
max	0.08	1.01	0.99	0.08	683.00	

Table A.4 IRFI Constants for 1999

Device tire configuration	*a*	*b*	R^2	StdError of Estimate	No of data points	Comment
BV11-OSL-T520-100	0.17	0.21	0.05	0.059	798	
SAR-MUN-AERO-100	0.14	0.32	0.11	0.062	678	
RFT-FAA-E1551-100	0.10	0.50	0.26	0.032	87	
ASFT-ASFT-AERO-100	0.10	0.49	0.37	0.052	607	
ERD-BLAZER	0.12	0.62	0.43	0.049	756	
ITTV-NASA-AC26-136	0.13	0.53	0.46	0.042	277	
ASFT-OSL-AERO-100	0.13	0.70	0.47	0.044	286	
SFT-TC79-E1551-100	0.09	0.88	0.63	0.040	1181	Even plot
GRT-NCAA-SLUSHCUT	0.02	0.93	0.65	0.031	432	
GRT-DND-E1844-20	0.02	0.94	0.67	0.036	490	Good, even plot
BV11-196-E1551-100	0.07	0.81	0.68	0.033	223	
GRT-NCAA-E1844-20	0.00	1.14	0.74	0.031	748	Good, even plot
min	0.00	0.21	0.05	0.03	87.00	
ave	0.09	0.67	0.46	0.04	546.92	
max	0.17	1.14	0.74	0.06	1181.00	

Table A.5 IRFI Constants for 2000

Device tire configuration	***a***	***b***	**R^2**	**StdError of Estimate**	**No of data points**
GRT-IF-E1844-20	0.23	0.28	0.10	0.052	24
ERD-BLAZER	0.16	0.56	0.43	0.096	286
GRT-IF-SLUSHCUT	0.12	0.62	0.64	0.057	60
SAR-MUN-AERO-100	0.19	0.38	0.65	0.058	55
BV11-ZUR-T49-20	0.25	0.31	0.66	0.060	24
SFT-TC85-E1551-100	0.17	0.59	0.68	0.121	49
RFT-FAA-E1551-100	0.11	0.80	0.71	0.068	104
ITTV-NASA-AC26-136	0.15	0.94	0.75	0.064	112
ASFT-801-AERO-100	0.14	0.68	0.76	0.061	120
BV11-196-E1551-100	0.14	0.61	0.78	0.090	91
SFT-HAN-AERO-100	0.17	0.56	0.78	0.059	114
SAR-813-AERO-100	0.15	0.57	0.79	0.061	102
ASFT-USFT-AERO-100	0.04	0.99	0.79	0.084	97
BV11-VIE-T520-100	0.16	0.56	0.81	0.056	108
SFT-TC79-E1551-100	0.13	0.83	0.88	0.023	66
min	0.04	0.28	0.10	0.02	24.00
ave	0.15	0.62	0.68	0.07	94.13
max	0.25	0.99	0.88	0.12	286.00

less poor R^2

Device tire configuration	***a***	***b***	**R^2**	**StdError of Estimate**	**No of data points**
RFT-FAA-E1551-100	0.11	0.80	0.71	0.068	104
ITTV-NASA-AC26-136	0.15	0.94	0.75	0.064	112
ASFT-801-AERO-100	0.14	0.68	0.76	0.061	120
BV11-196-E1551-100	0.14	0.61	0.78	0.090	91
SFT-HAN-AERO-100	0.17	0.56	0.78	0.059	114
SAR-813-AERO-100	0.15	0.57	0.79	0.061	102
ASFT-USFT-AERO-100	0.04	0.99	0.79	0.084	97
BV11-VIE-T520-100	0.16	0.56	0.81	0.056	108
SFT-TC79-E1551-100	0.13	0.83	0.88	0.023	66
min	0.04	0.56	0.71	0.02	66.00
ave	0.13	0.73	0.78	0.06	101.56
max	0.17	0.99	0.88	0.09	120.00

Table A.6 IRFI Constants for 2001

Device tire configuration	***a***	***b***	**R^2**	**Std Error of Estimate**	**No of data points**	**Comment**
ASFT-801-AERO-100	0.11	0.78	0.41	0.043	54	
ASFT-801-UNIT-100	0.09	0.64	0.56	0.072	136	
SAR-527-AERO-100	0.02	0.93	0.77	0.093	171	
ERD-BLAZER	0.10	0.75	0.77	0.097	215	
SAR-814-AERO-100	0.21	0.61	0.78	0.089	156	
SAR-813-AERO-100	0.16	0.66	0.82	0.080	159	
ASFT-801-E1551-30	0.07	0.84	0.85	0.095	125	
SAR-MUN-AERO-100	0.03	0.79	0.88	0.070	180	
BV11-VIE-T520-100	0.08	0.77	0.89	0.073	306	
SAR-MUN-E1551-30	0.08	0.65	0.92	0.074	126	
BV11-ZUR-T49-20	0.07	0.69	0.93	0.060	267	
SFT-TC79-E1551-100	0.09	0.72	0.93	0.056	240	
SAR-527-E1551-30	0.09	0.79	0.94	0.066	120	
SAR-814-TRBL-30	0.10	0.69	0.94	0.061	150	
SAR-813-E1551-30	0.08	0.79	0.94	0.061	156	
SFT-TC79-AERO-100	0.07	0.72	0.98	0.039	78	Two data clusters
min	0.02	0.61	0.41	0.04	54.00	
ave	0.09	0.74	0.83	0.07	164.94	
max	0.21	0.93	0.98	0.10	306.00	

less poor R^2

Device tire configuration	***a***	***b***	**R^2**	**Std Error of Estimate**	**No of data points**	**Comment**
SAR-527-AERO-100	0.02	0.93	0.77	0.093	171	
ERD-BLAZER	0.10	0.75	0.77	0.097	215	
SAR-814-AERO-100	0.21	0.61	0.78	0.089	156	
SAR-813-AERO-100	0.16	0.66	0.82	0.080	159	
ASFT-801-E1551-30	0.07	0.84	0.85	0.095	125	
SAR-MUN-AERO-100	0.03	0.79	0.88	0.070	180	
BV11-VIE-T520-100	0.08	0.77	0.89	0.073	306	
SAR-MUN-E1551-30	0.08	0.65	0.92	0.074	126	
BV11-ZUR-T49-20	0.07	0.69	0.93	0.060	267	
SFT-TC79-E1551-100	0.09	0.72	0.93	0.056	240	
SAR-527-E1551-30	0.09	0.79	0.94	0.066	120	
SAR-814-TRBL-30	0.10	0.69	0.94	0.061	150	
SAR-813-E1551-30	0.08	0.79	0.94	0.061	156	
SFT-TC79-AERO-100	0.07	0.72	0.98	0.039	78	
min	0.02	0.61	0.77	0.04	78.00	Two data clusters
ave	0.09	0.74	0.88	0.07	174.93	
max	0.21	0.93	0.98	0.10	306.00	

Table A.7 IRFI Constants for 2002

Device	Torque *a*	Torque *b*	Torque R2	Force *a*	Force *b*	Force R2	Std Error of Estimate	No of Points
ASFT-801-E1551-100	0.7382	0.1261	0.8597				0.04555	30
ASFT-801-UNIT-100	0.7299	0.0991	0.8161				0.04082	21
ASFT-810-E1551-100	0.8008	0.0902	0.8415				0.04842	30
BV11-196-E1551-100	0.8512	0.0125	0.8902				0.03355	312
BV11-VIE-T520-100	0.5565	0.0978	0.7088				0.06410	48
ERD-BLAZER				0.8373	0.0752	0.7049	0.06387	558
GRT-211-E1844-20				0.9966	0.0123	0.6256	0.02426	120
RFT-FAA-E1551-100				0.7562	0.0477	0.9195	0.02811	324
SAR-527-E1551-100	0.5953	0.1312	0.7778				0.05733	30
SAR-527-UNIT-100	0.6269	0.1426	0.8274				0.03772	30
SAR-805-E1551-100	0.7154	0.1362	0.9417				0.02954	24
SAR-805-UNIT-100	0.5869	0.1461	0.7423				0.04610	30
SAR-813-UNIT-100	0.6038	0.1045	0.8409				0.03622	30
SAR-814-E1551-100	0.6353	0.1268	0.8285				0.05036	30
SAR-814-E1551-30	0.5513	0.1764	0.8351				0.03687	30
SFT-212-E1551-100	0.6315	0.1308	0.8904				0.03897	60
SFT-511-E1551-100	0.6258	0.1521	0.9316				0.08370	30
SFT-511-UNIT-100	0.5249	0.1886	0.7395				0.04565	24
SFT-99-E1551-100	0.7773	0.0011	0.8308				0.04033	387
TATRA-613-E1551-100	0.5857	0.0713	0.4264				0.08769	30
min	0.52	0.00	0.43	0.76	0.01	0.63	0.02	21.00
ave	0.66	0.11	0.81	0.86	0.05	0.75	0.05	108.90
max	0.85	0.19	0.94	1.00	0.08	0.92	0.09	558.00

APPENDIX B

Plots of Aircraft Braking Coefficient (Mu) versus GFMD Friction Measurements
and Calculated IRFI Values

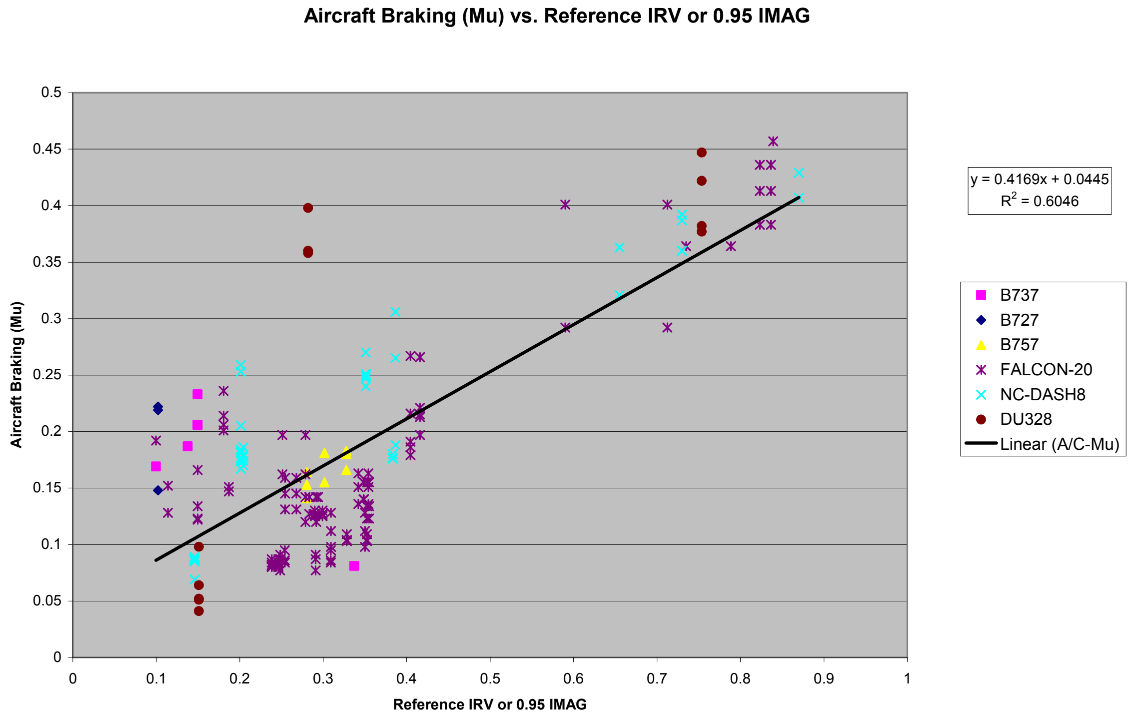

Figure B1A. Aircraft Braking versus Reference (IRV or 0.95 IMAG) Measurements

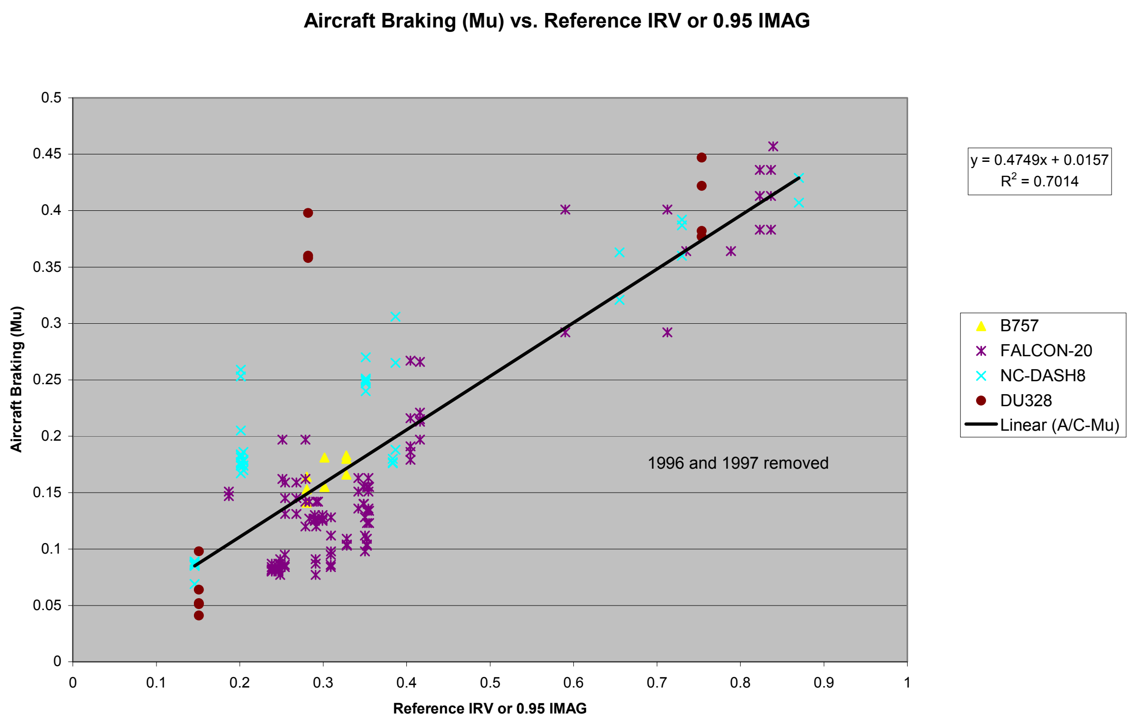

Figure B1B. Aircraft Braking versus Reference (IRV or 0.95 IMAG) Measurements with 1996 and 1997 Removed

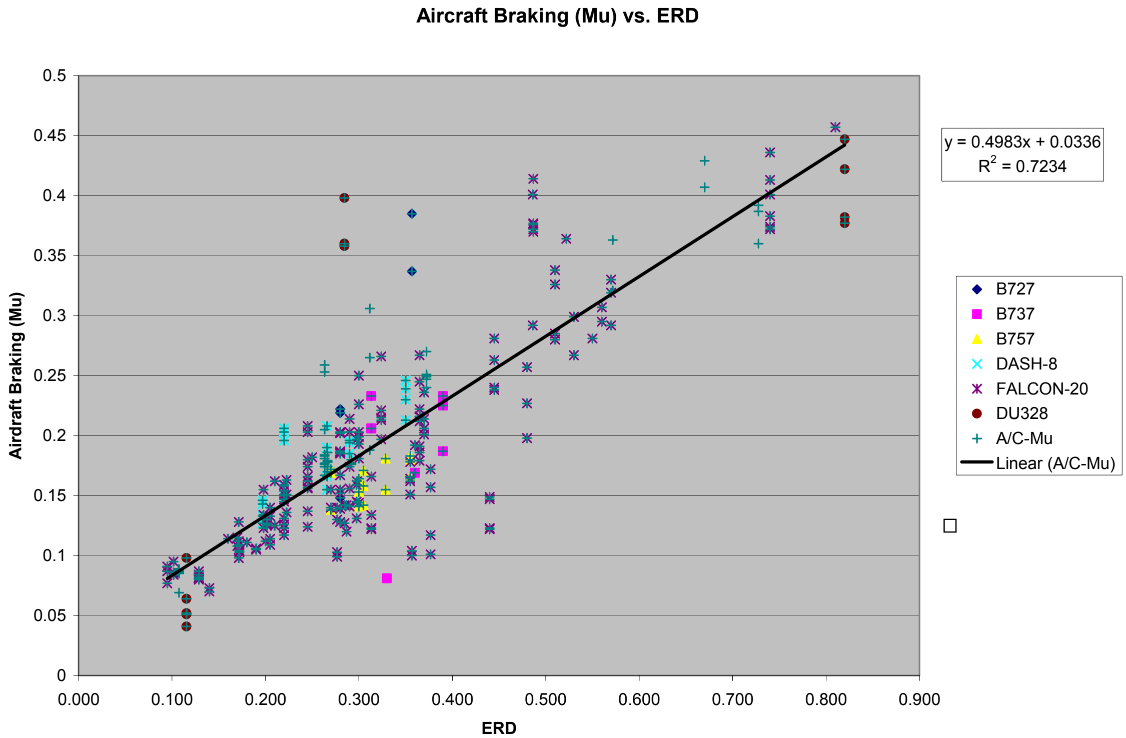

Figure B2A. Aircraft Braking versus ERD Measurements

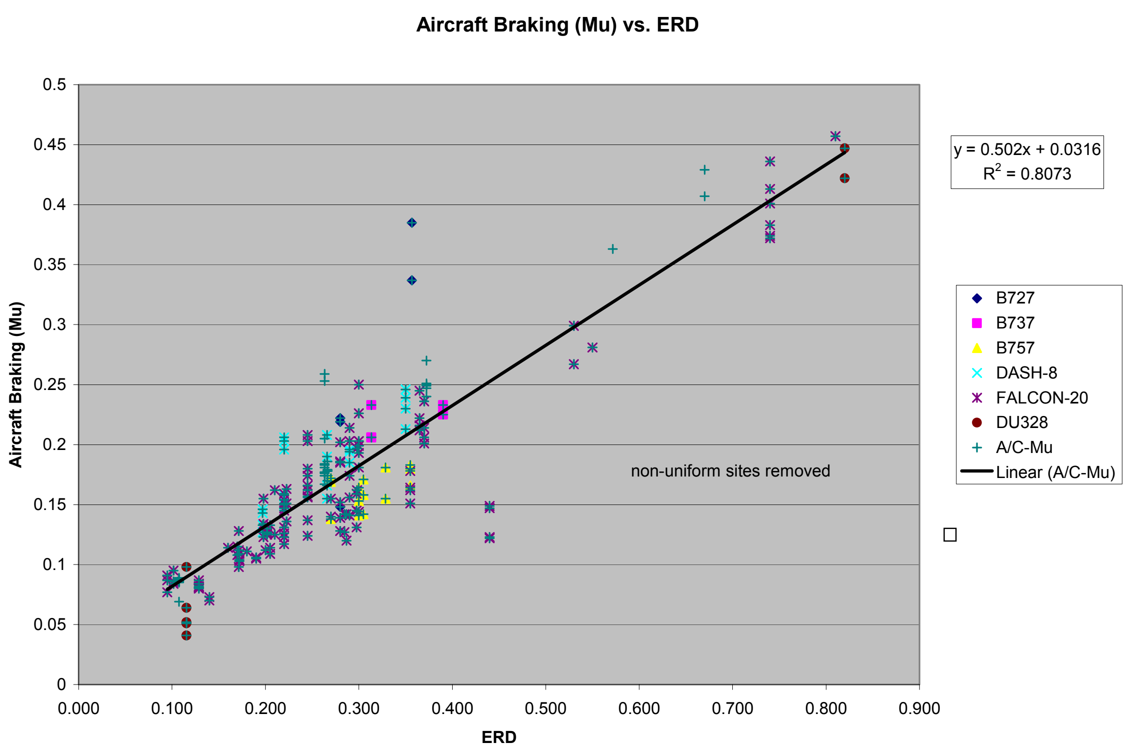

Figure B2B. Aircraft Braking versus ERD Measurements with Non-uniform Sites Removed

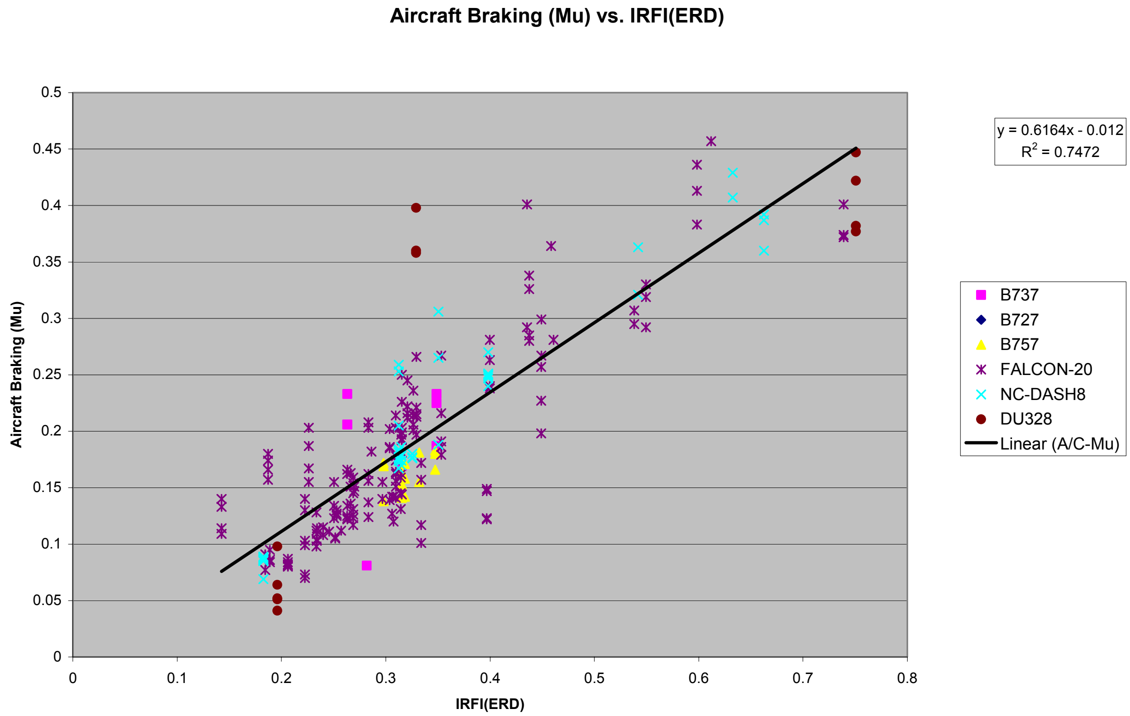

Figure B2C. Aircraft Braking versus IRFI(ERD)

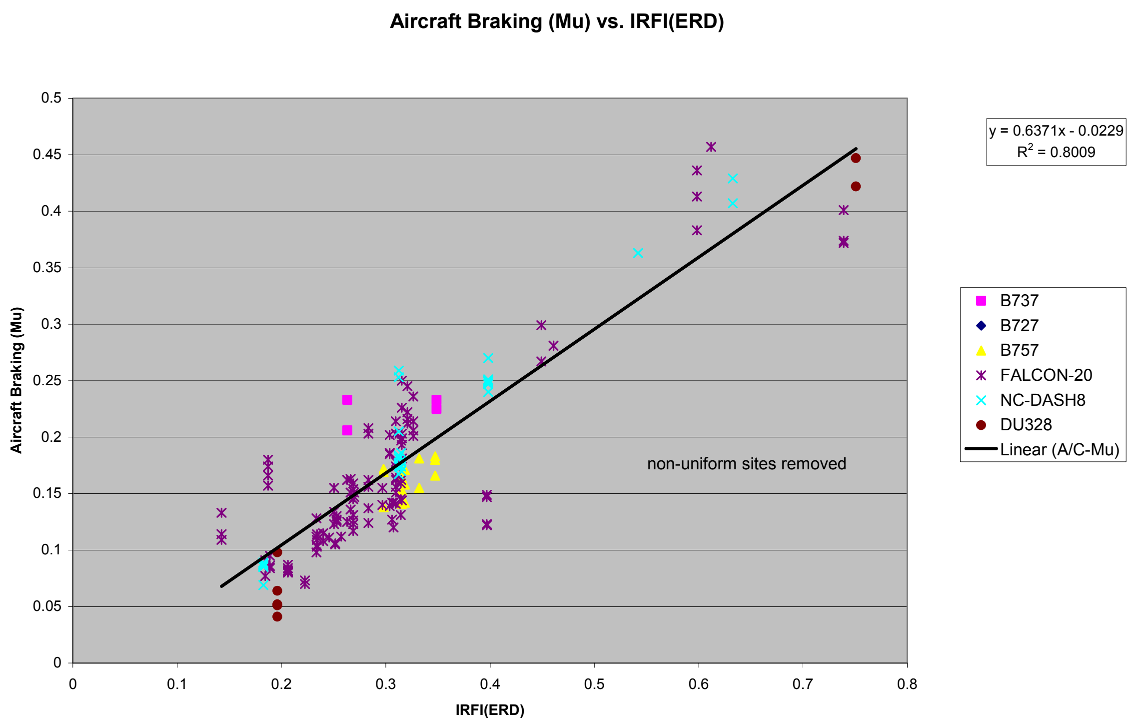

Figure B2D. Aircraft Braking versus IRFI(ERD) with Non-uniform Sites Removed

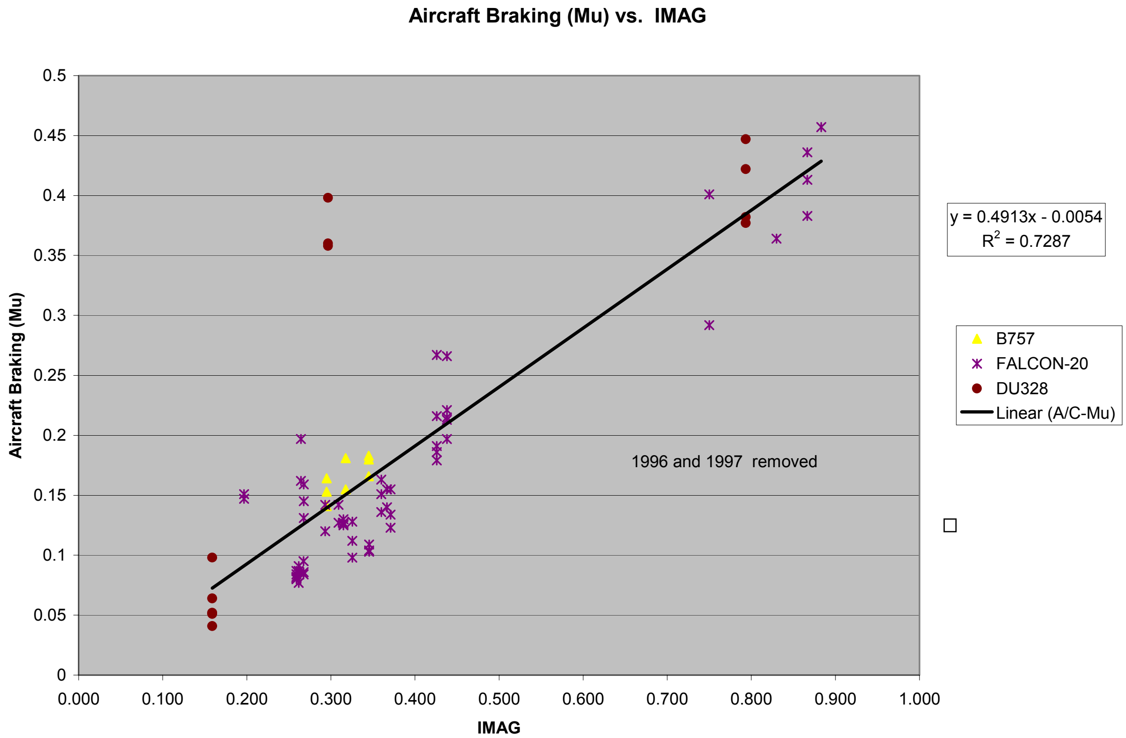

Figure B3A. Aircraft Braking versus IMAG Force Measurements

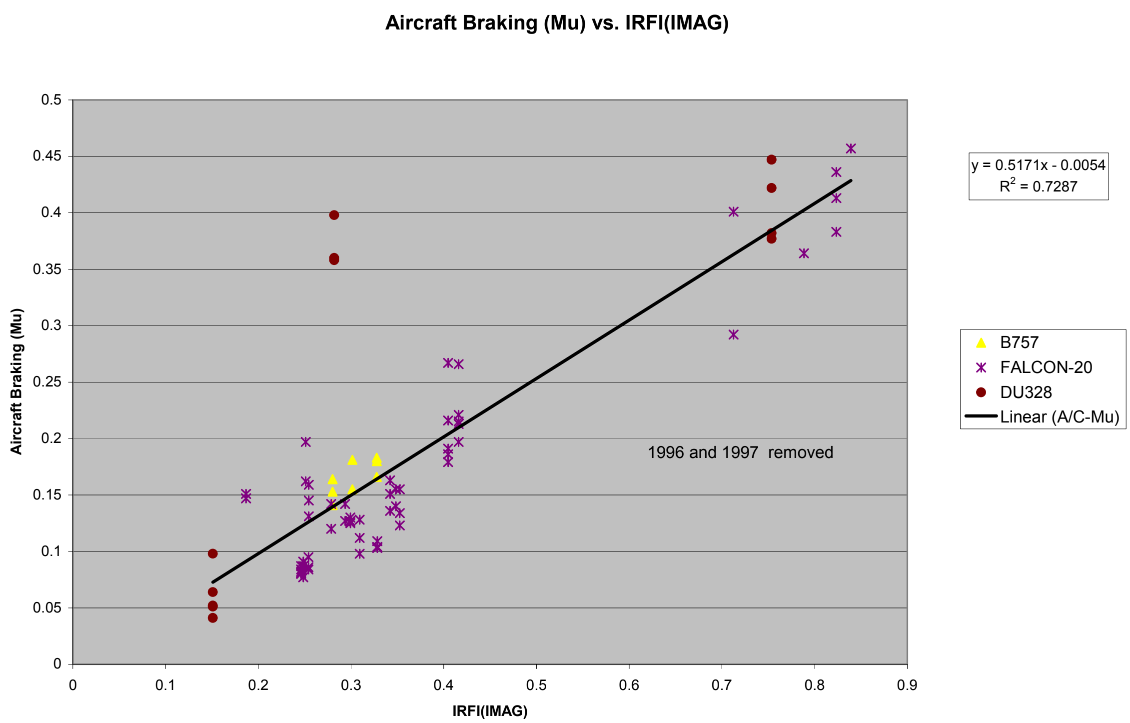

Figure B3B. Aircraft Braking versus IRFI(IMAG)

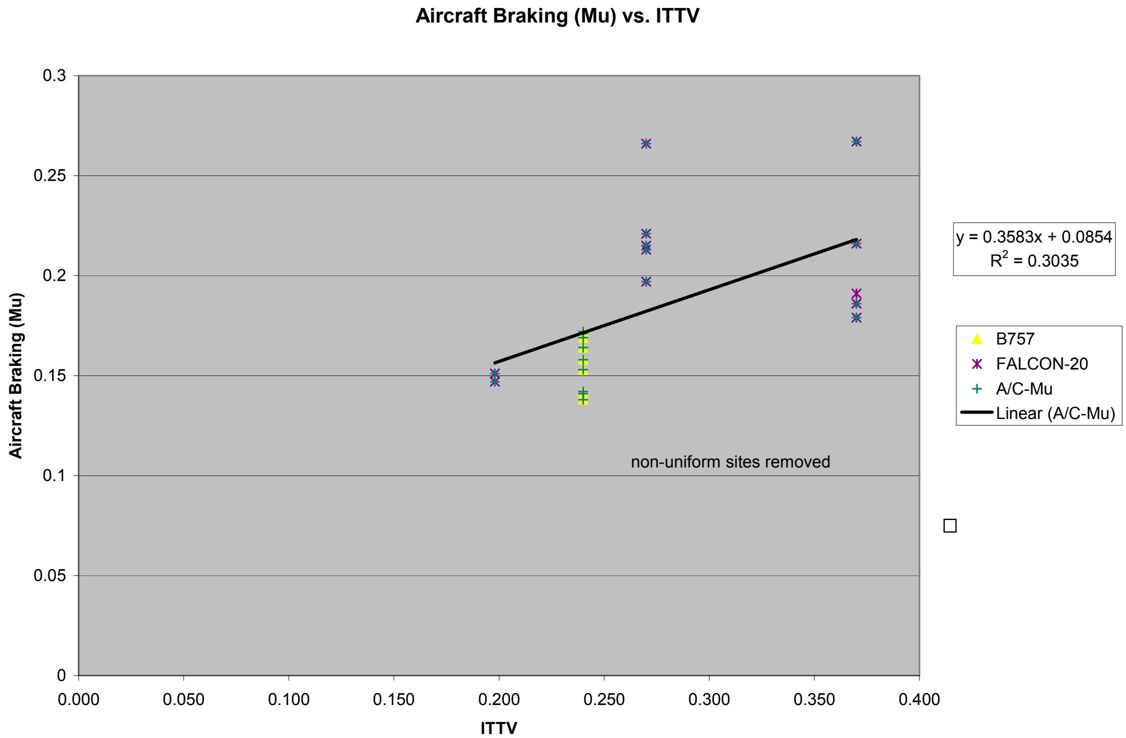

Figure B4A. Aircraft Braking versus ITTV Measurements

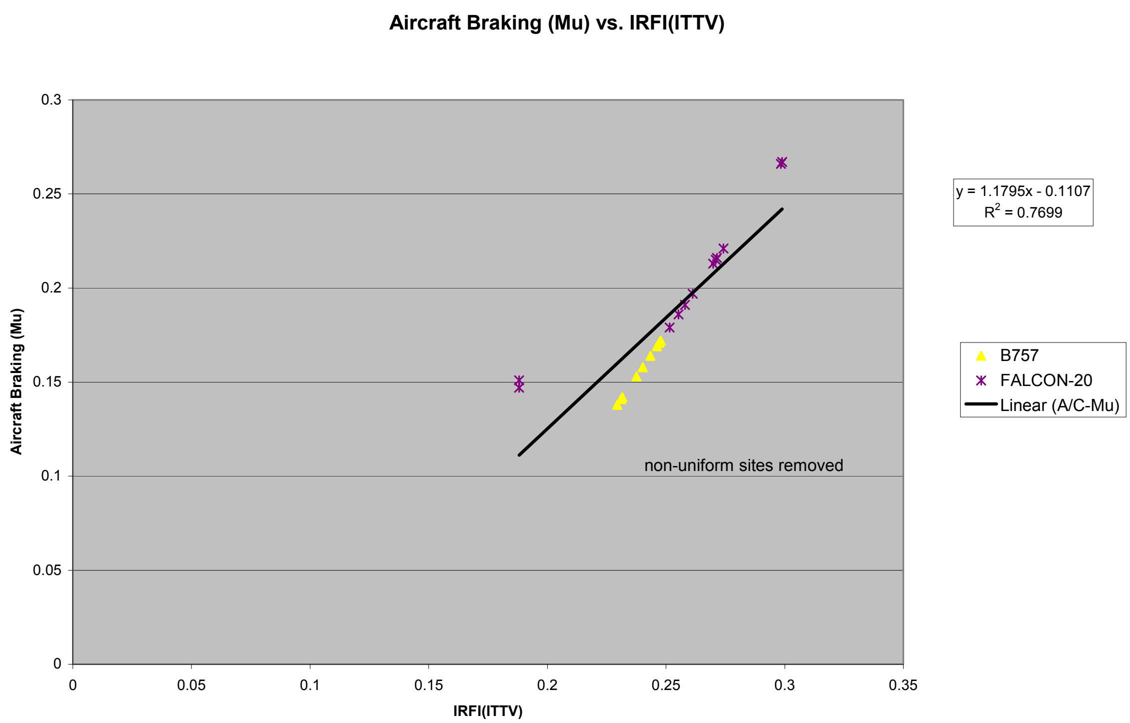

Figure B4B. Aircraft Braking versus IRFI(ITTV)

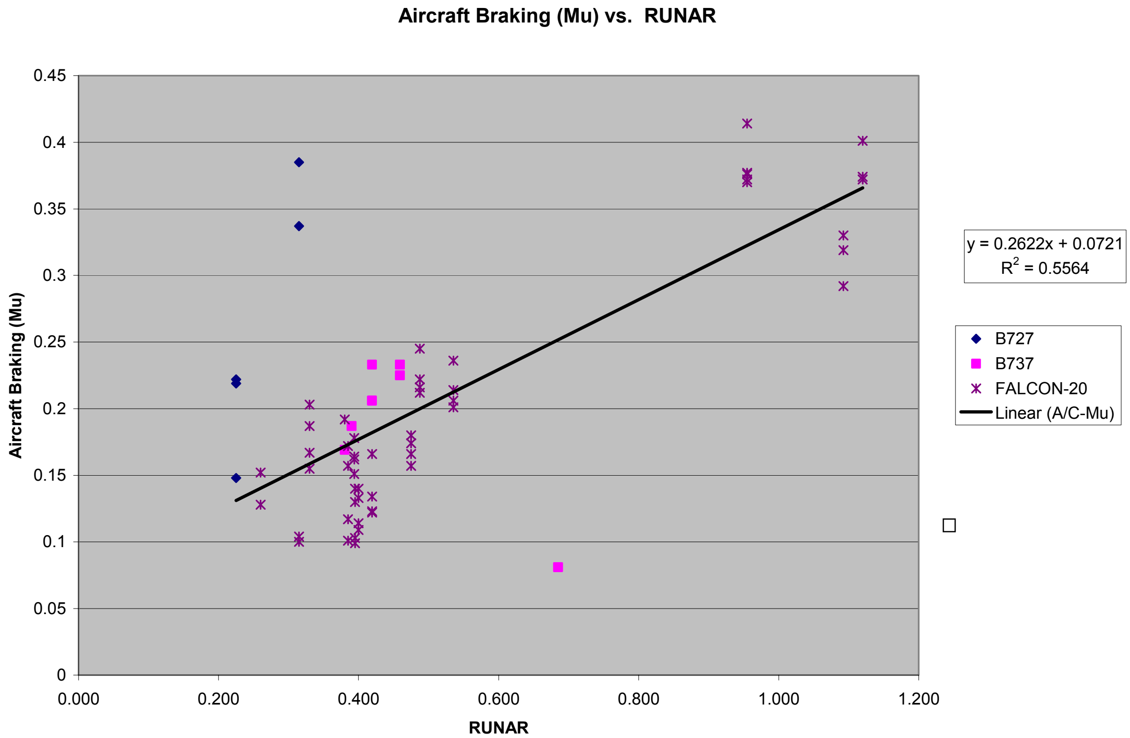

Figure B5A. Aircraft Braking versus RUNAR Measurements

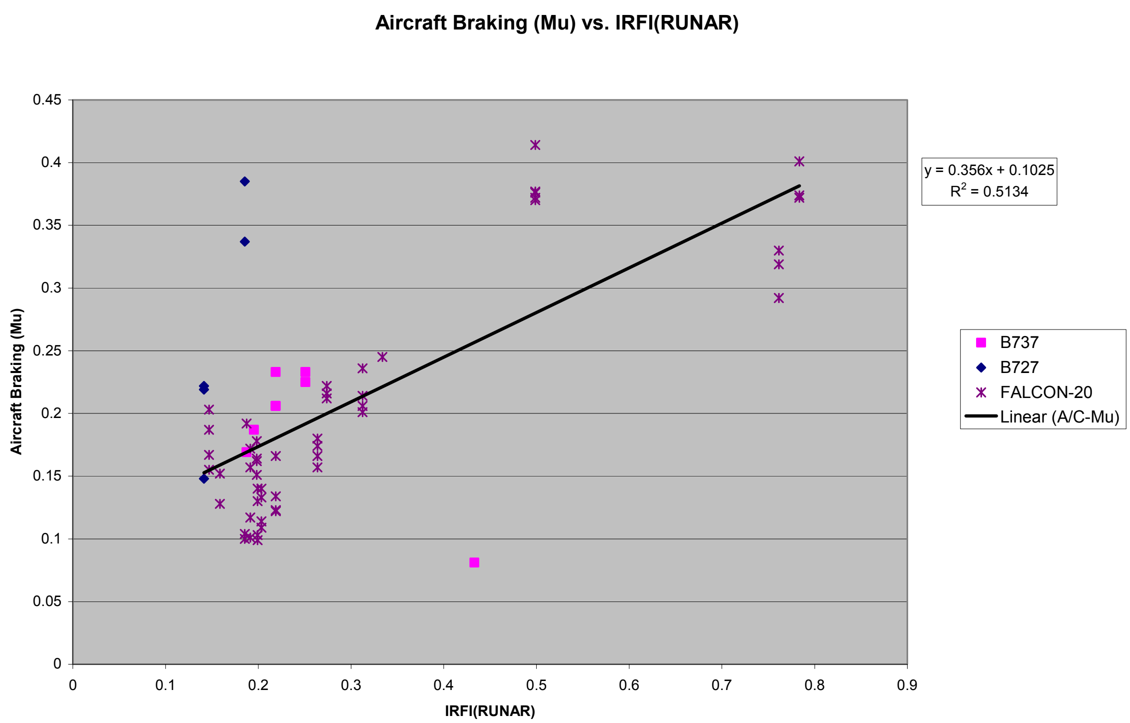

Figure B5B. Aircraft Braking versus IRFI(RUNAR)

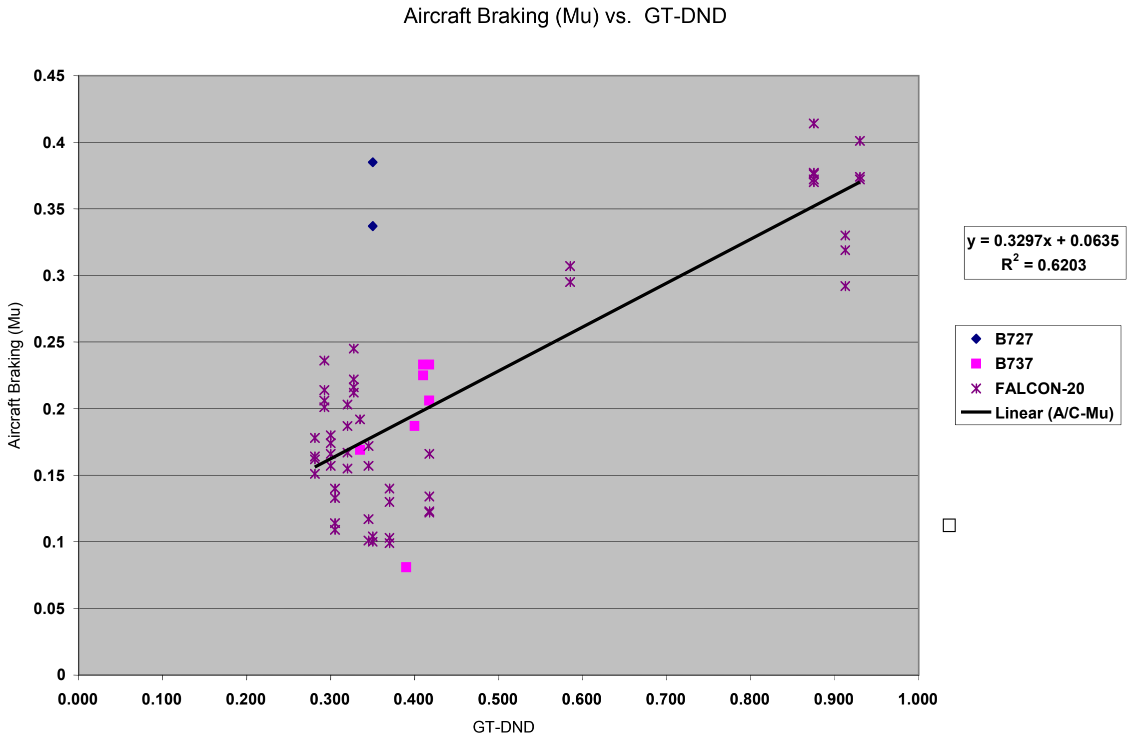

Figure B6A. Aircraft Braking versus GripTester-DND Measurements

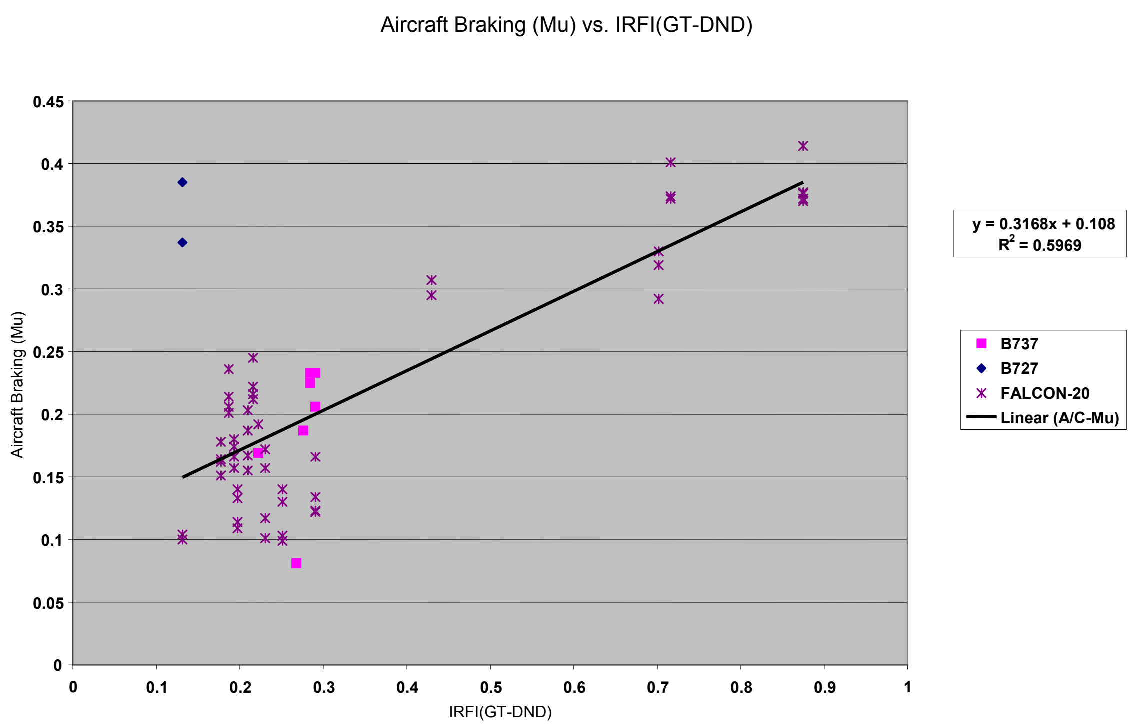

Figure B6B. Aircraft Braking versus IRFI(GripTester-DND)

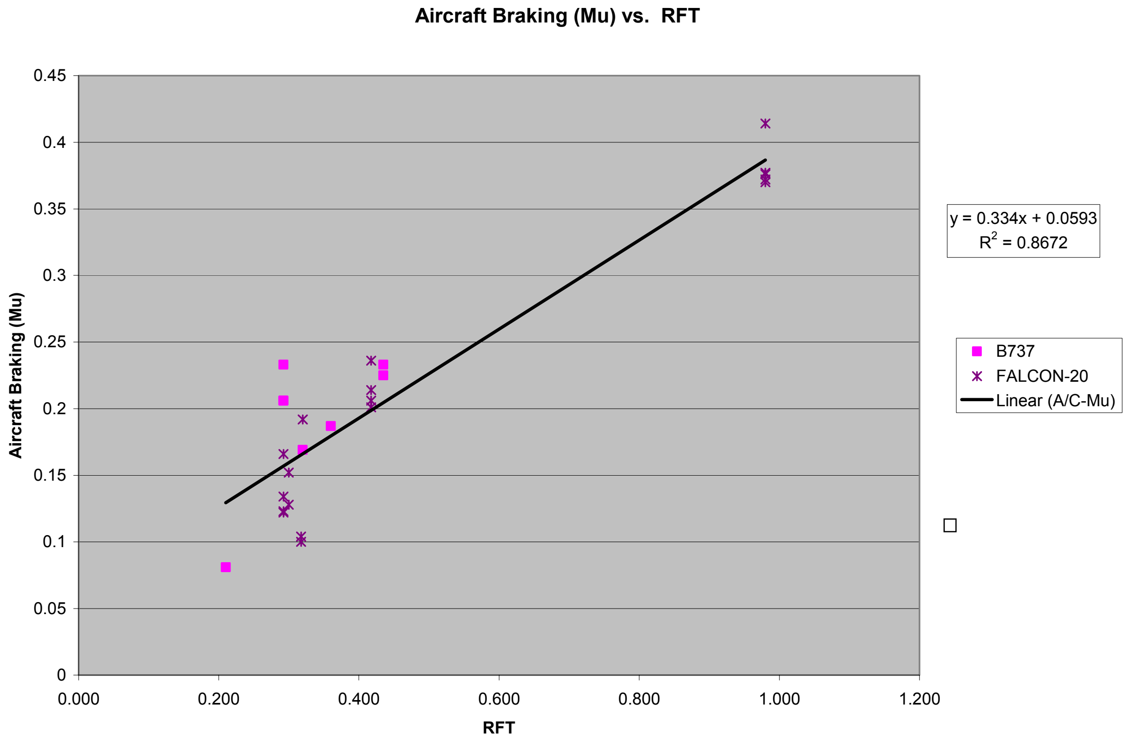

Figure B7A. Aircraft Braking versus RFT Measurements

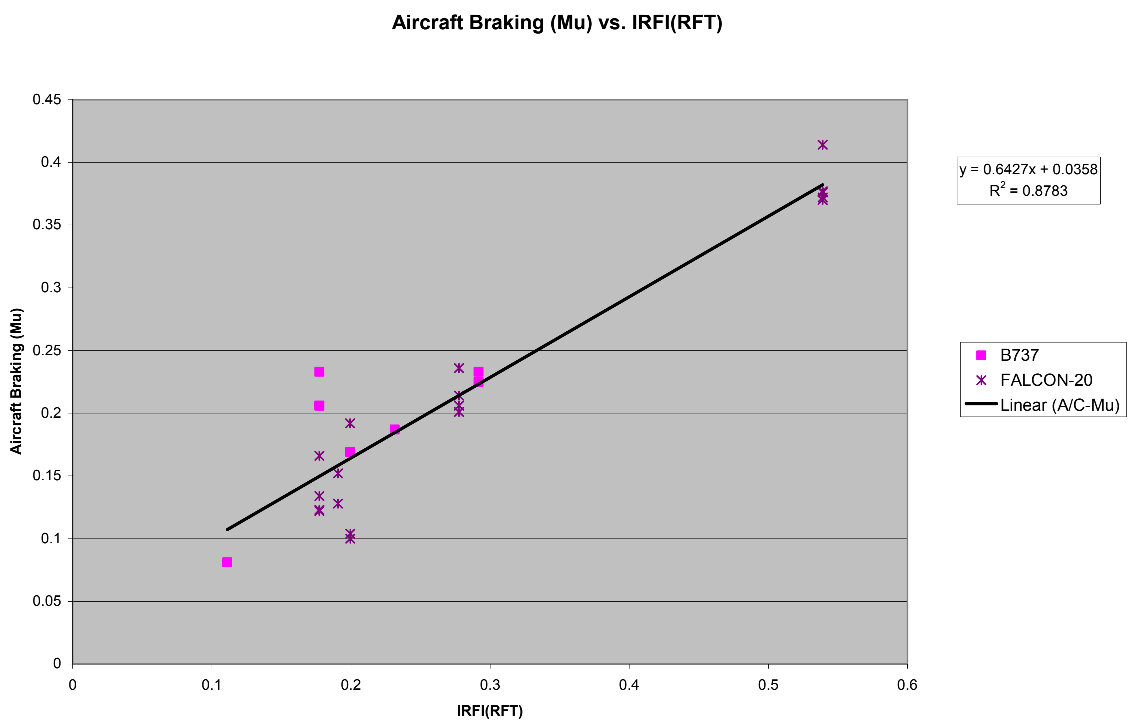

Figure B7B. Aircraft Braking versus IRFI(RFT)

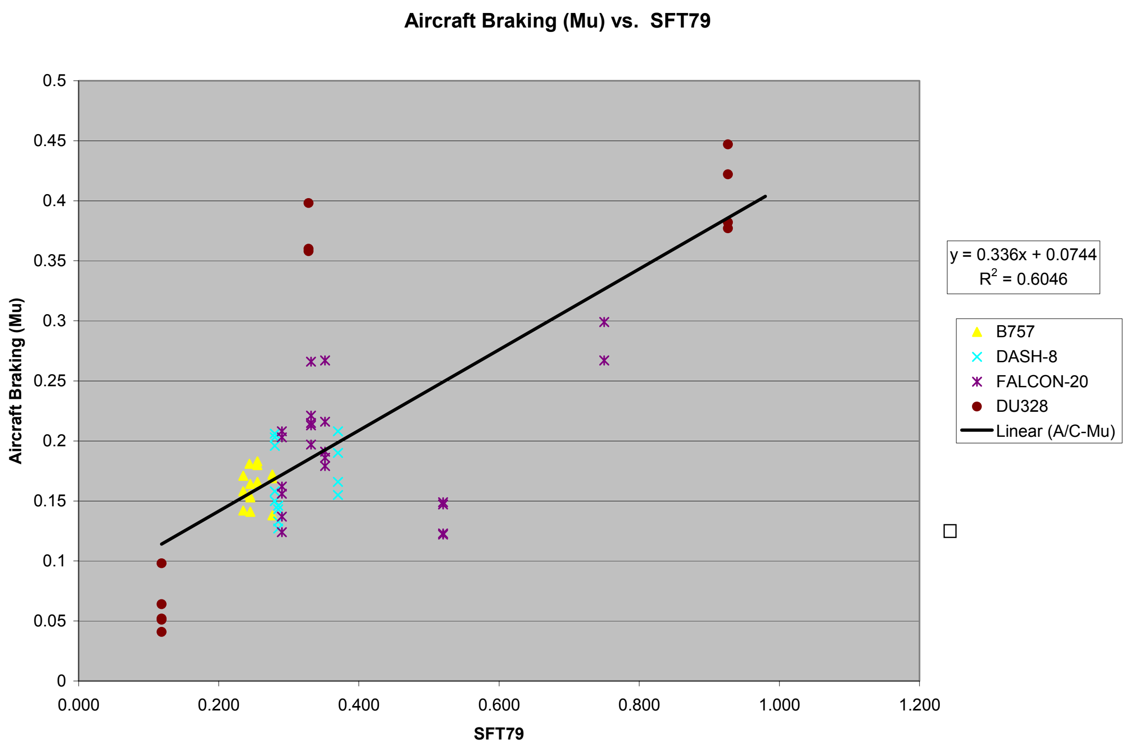

Figure B8A. Aircraft Braking versus SFT79 Measurements

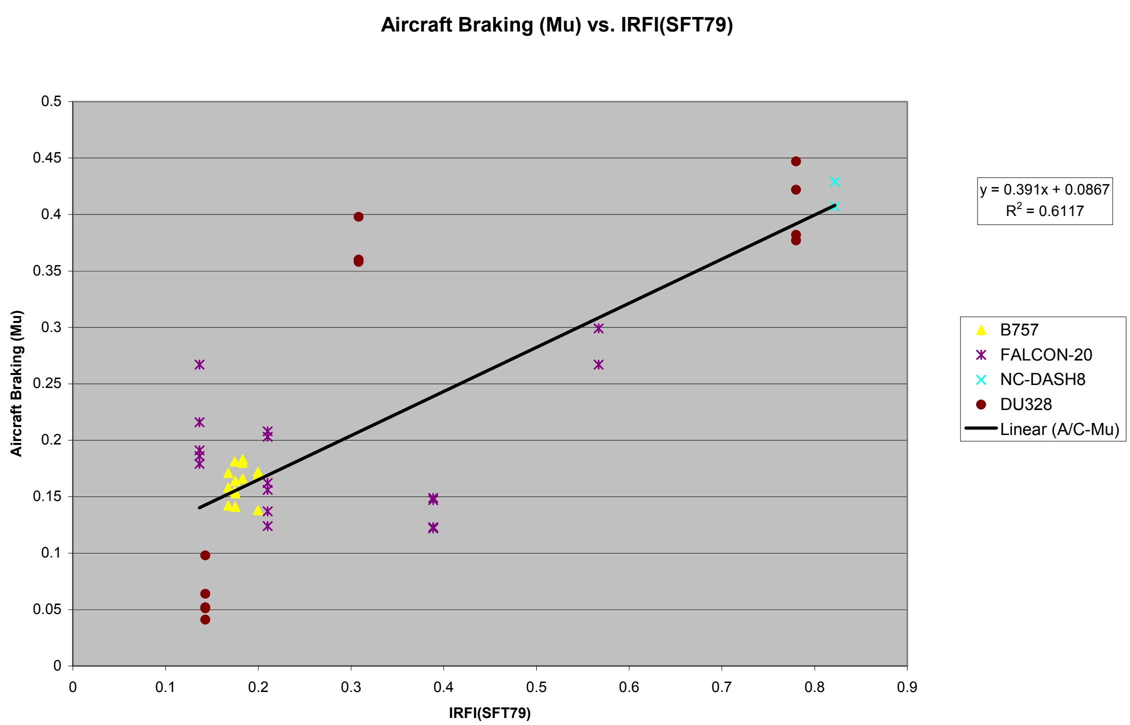

Figure B8B. Aircraft Braking versus IRFI(SFT79)

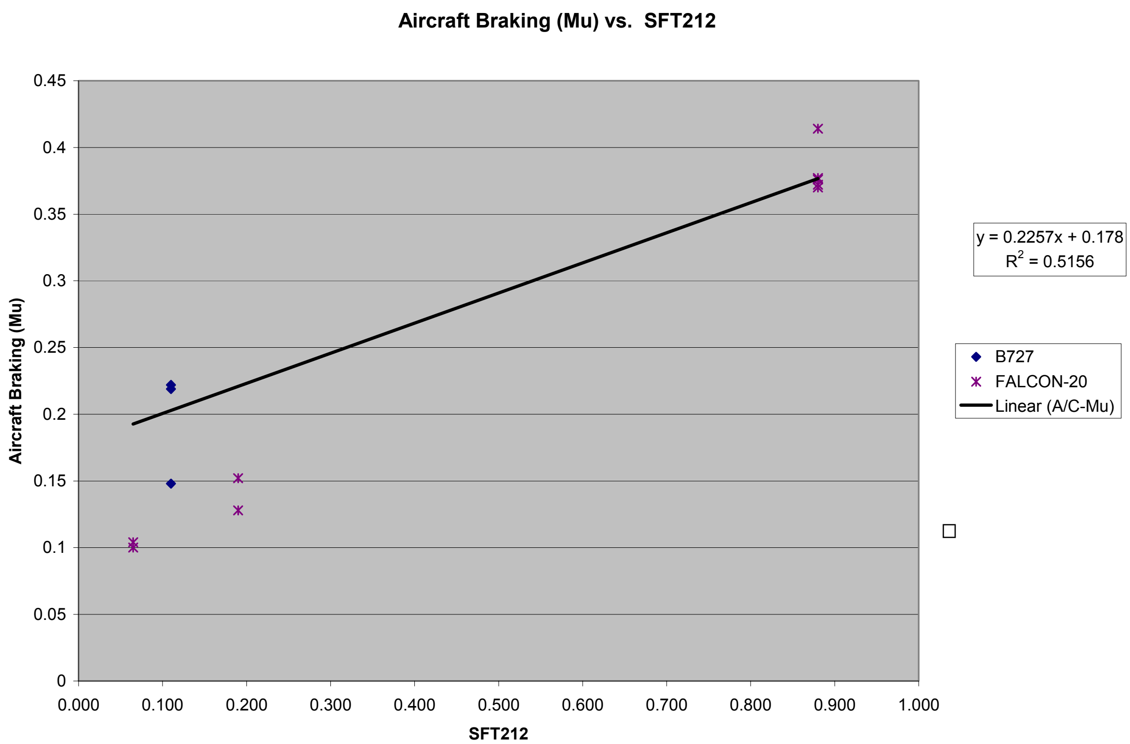

Figure B9A. Aircraft Braking versus SFT212 Measurements

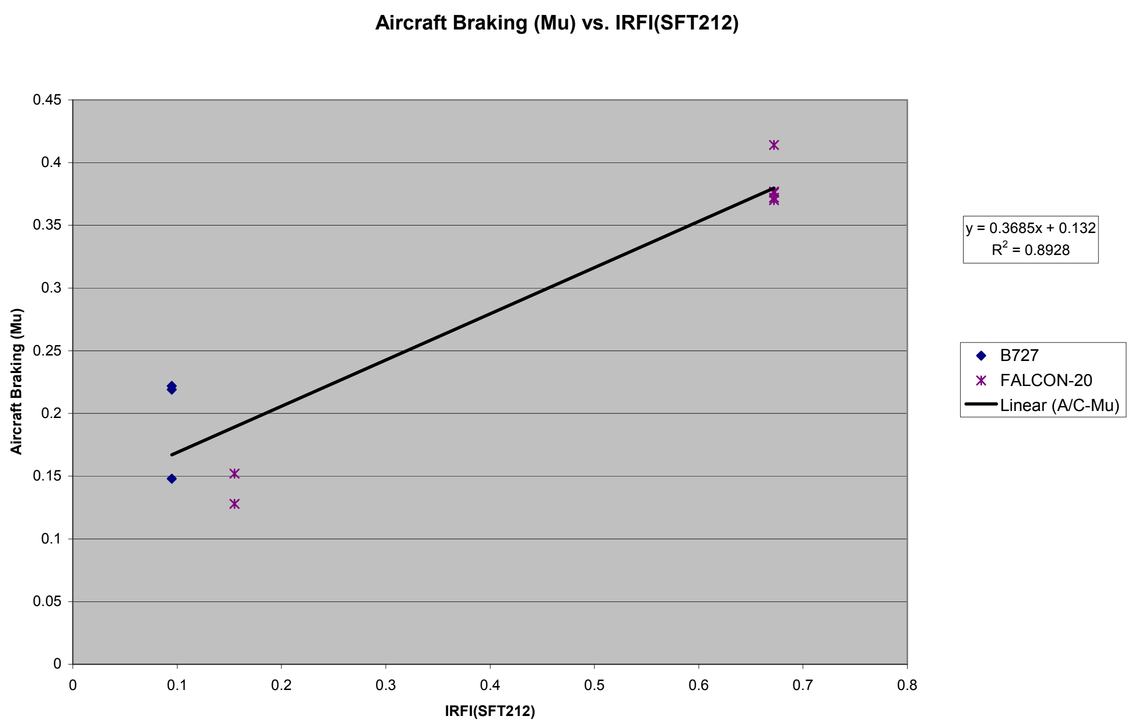

Figure B9B. Aircraft Braking versus IRFI(SFT212)

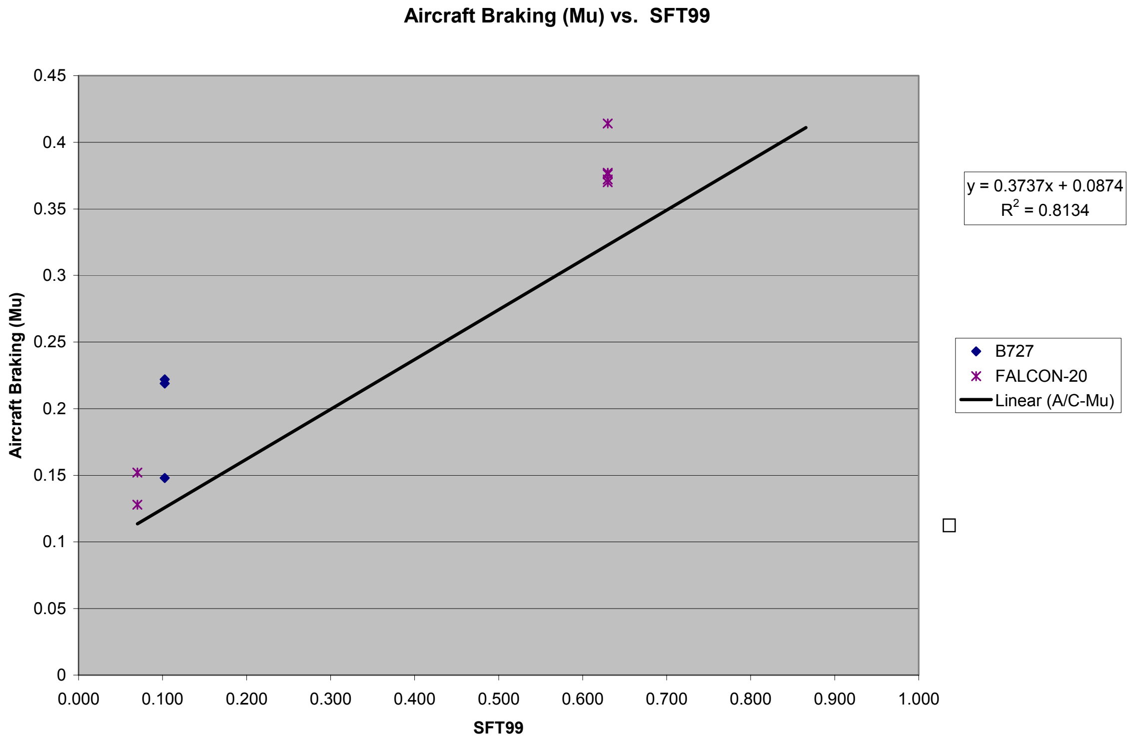

Figure B10A. Aircraft Braking versus SFT99 Measurements

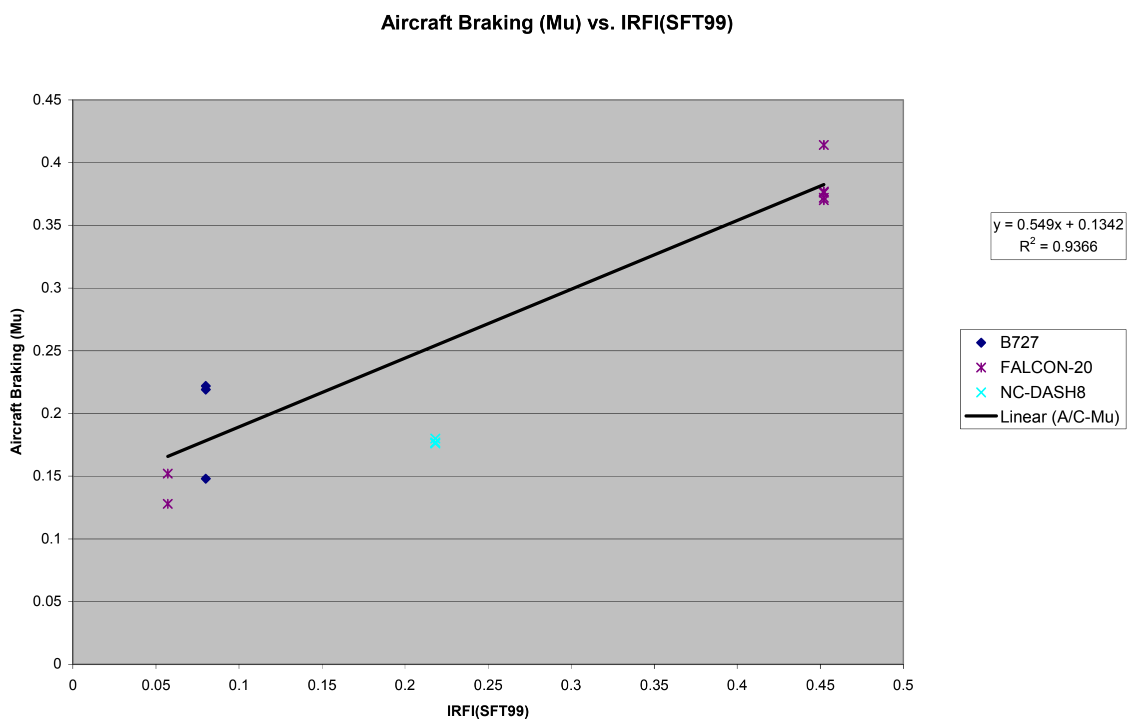

Figure B10B. Aircraft Braking versus IRFI(SFT99)

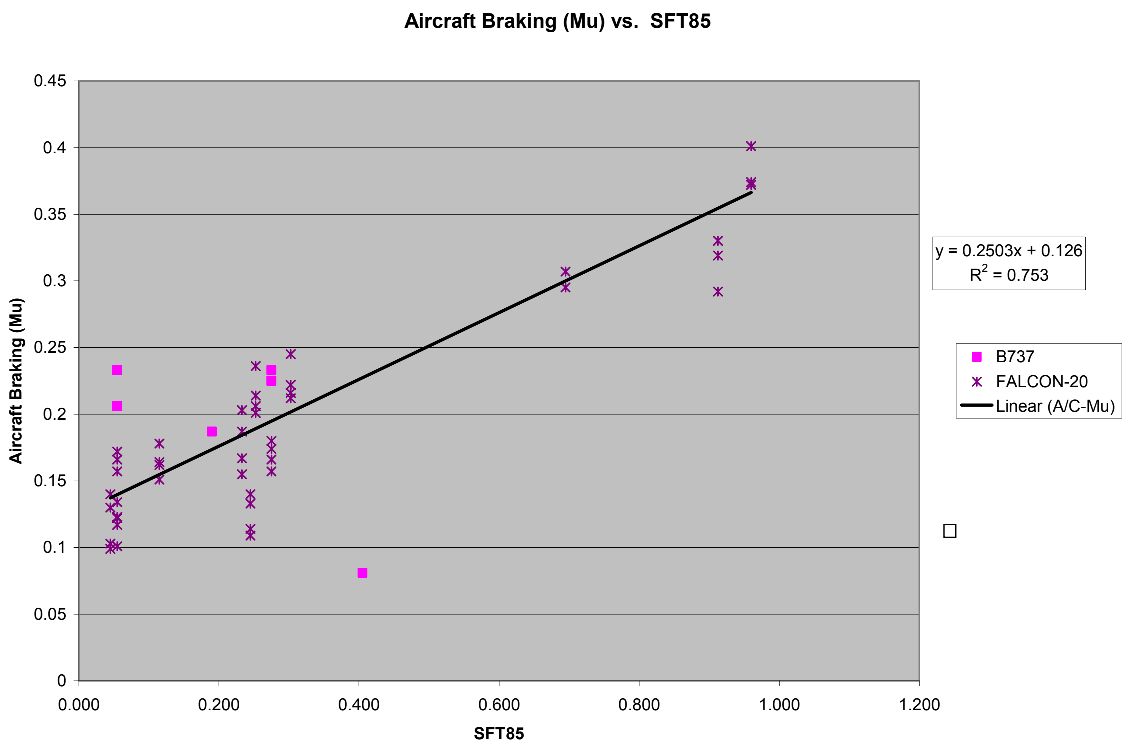

Figure B11A. Aircraft Braking versus SFT85 Measurements

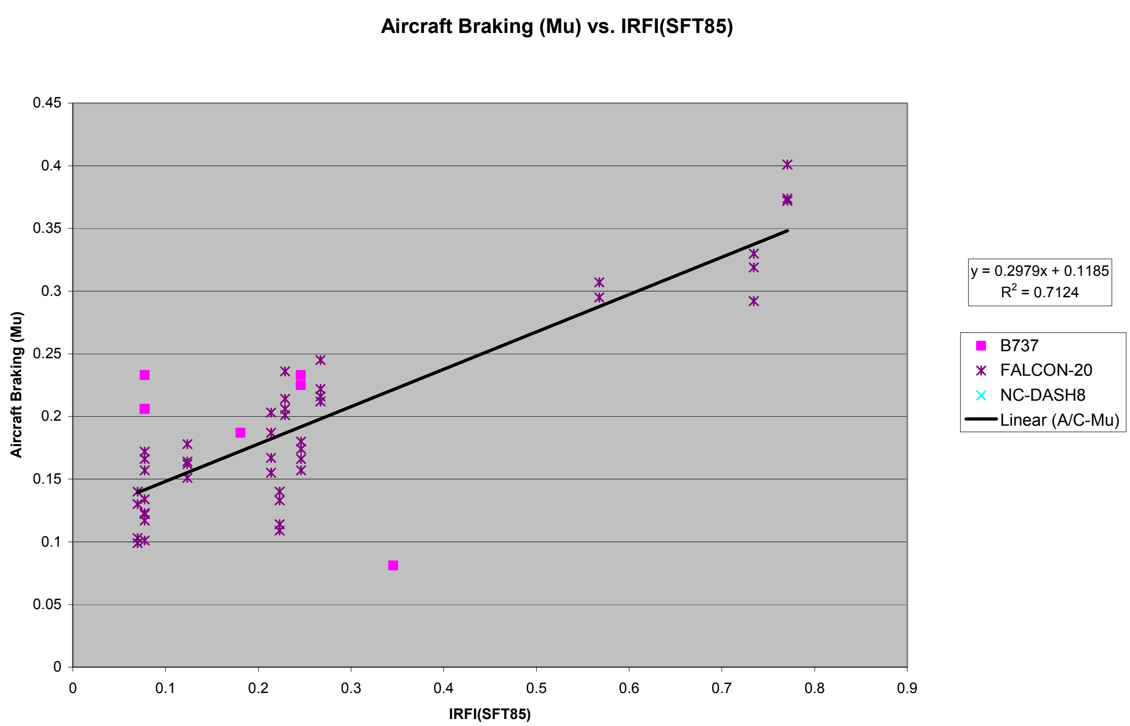

Figure B11B. Aircraft Braking versus IRFI(SFT85)

APPENDIX C

Compilation of Aircraft Braking Coefficient and GFMD Friction Measurements and IRFI Data by Aircraft Type

In the last two columns, the code is as follows:

Uniform:

- OK = the points meet the uniform requirement
- NO = the point does not meet the uniform requirement

Cut:

- OK = the point was OK and was not cut
- YES = the point was cut

GFMD	A/C	Date	Type	G-F&T	A/C-Mu	IRFI	A/C-Mu	Uniform	Cut Points
				G-F&T	B727	IRFI	B727	OK	OK
ERD-BLAZER	B727	1/24/1997	force	**0.357**	0.385		0.385	OK	OK
ERD-BLAZER	B727	1/24/1997	force	**0.357**	0.337		0.337	OK	OK
ERD-BLAZER	B727	1/29/1997	force	0.280	0.148		0.148	OK	OK
ERD-BLAZER	B727	1/29/1997	force	0.280	0.219		0.219	OK	OK
ERD-BLAZER	B727	1/29/1997	force	0.280	0.222		0.222	OK	OK
GRT-DND-STD	B727	1/29/1997	force	0.310	0.148	0.135	0.148	OK	OK
GRT-DND-STD	B727	1/29/1997	force	0.310	0.219	0.135	0.219	OK	OK
GRT-DND-STD	B727	1/29/1997	force	0.310	0.222	0.135	0.222	OK	OK
GT-TC-E1844-20	B727	1/24/1997	force	0.350	0.385	0.131	0.385	OK	yes
GT-TC-E1844-20	B727	1/24/1997	force	0.350	0.337	0.131	0.337	OK	yes
IMAG-STBA-PIARC-22	B727	1/29/1997	torque	0.108	0.148	0.102	0.148	OK	OK
IMAG-STBA-PIARC-22	B727	1/29/1997	torque	0.108	0.219	0.102	0.219	OK	OK
IMAG-STBA-PIARC-22	B727	1/29/1997	torque	0.108	0.222	0.102	0.222	OK	OK
RFT-FAA-E1551-30	B727	1/24/1997	force	0.318	0.385	0.200	0.385	OK	OK
RFT-FAA-E1551-30	B727	1/24/1997	force	0.318	0.337	0.200	0.337	OK	OK
RUNAR-NATAM-E1551-V-30	B727	1/24/1997	force	0.315	0.385	0.185	0.385	OK	OK
RUNAR-NATAM-E1551-V-30	B727	1/24/1997	force	0.315	0.337	0.185	0.337	OK	OK
RUNAR-NATAM-E1551-V-30	B727	1/29/1997	force	0.225	0.148	0.141	0.148	OK	OK
RUNAR-NATAM-E1551-V-30	B727	1/29/1997	force	0.225	0.219	0.141	0.219	OK	OK
RUNAR-NATAM-E1551-V-30	B727	1/29/1997	force	0.225	0.222	0.141	0.222	OK	OK
SFT-212-E1551-30	B727	1/29/1997	torque	0.110	0.148	0.095	0.148	OK	OK
SFT-212-E1551-30	B727	1/29/1997	torque	0.110	0.219	0.095	0.219	OK	OK
SFT-212-E1551-30	B727	1/29/1997	torque	0.110	0.222	0.095	0.222	OK	OK
SFT-99-AERO-100	B727	1/29/1997	torque	0.102	0.148	0.080	0.148	OK	OK
SFT-99-AERO-100	B727	1/29/1997	torque	0.102	0.219	0.080	0.219	OK	OK
SFT-99-AERO-100	B727	1/29/1997	torque	0.102	0.222	0.080	0.222	OK	OK
SFT-TC79-E1551RIB-30	B727	1/29/1997	torque	0.145	0.148	0.113	0.148	OK	OK
SFT-TC79-E1551RIB-30	B727	1/29/1997	torque	0.145	0.219	0.113	0.219	OK	OK
SFT-TC79-E1551RIB-30	B727	1/29/1997	torque	0.145	0.222	0.113	0.222	OK	OK
IMAG-STBA-PIARC-22	B727	1/24/1997	torque	0.050	0.385		0.385	OK	Yes
IMAG-STBA-PIARC-22	B727	1/24/1997	torque	0.050	0.337		0.337	OK	Yes
SFT-TC79-E1551RIB-30	B727	1/24/1997	torque	0.060	0.385		0.385	OK	Yes
SFT-TC79-E1551RIB-30	B727	1/24/1997	torque	0.060	0.337		0.337	OK	Yes
SFT-212-E1551-30	B727	1/24/1997	torque	0.065	0.385		0.385	OK	Yes
SFT-212-E1551-30	B727	1/24/1997	torque	0.065	0.337		0.337	OK	Yes
				G-F&T	B737	IRFI	B737		
ERD-BLAZER	B737	3/6/1996	force	0.390	0.225	0.349	0.225	OK	OK
ERD-BLAZER	B737	3/6/1996	force	0.390	0.233	0.349	0.233	OK	OK
ERD-BLAZER	B737	3/7/1996	force	0.313	0.206	0.263	0.206	OK	OK
ERD-BLAZER	B737	3/7/1996	force	0.313	0.233	0.263	0.233	OK	OK
ERD-BLAZER	B737	3/7/1996	force	0.313	0.206	0.263	0.206	OK	OK
ERD-BLAZER	B737	3/7/1996	force	0.390	0.187	0.349	0.187	NO	OK
ERD-BLAZER	B737	3/7/1996	force	0.360	0.169	0.315	0.169	NO	OK
ERD-BLAZER	B737	3/8/1996	force	**0.330**	0.081	0.282	0.081	NO	OK
GT-TC-E1844-20	B737	3/6/1996	force	0.410	0.225	0.284	0.225	OK	OK
GT-TC-E1844-20	B737	3/6/1996	force	0.410	0.233	0.284	0.233	OK	OK
GT-TC-E1844-20	B737	3/7/1996	force	0.417	0.206	0.291	0.206	OK	OK
GT-TC-E1844-20	B737	3/7/1996	force	0.417	0.233	0.291	0.233	OK	OK
GT-TC-E1844-20	B737	3/7/1996	force	0.417	0.206	0.291	0.206	OK	OK
GT-TC-E1844-20	B737	3/7/1996	force	0.400	0.187	0.276	0.187	NO	OK
GT-TC-E1844-20	B737	3/7/1996	force	0.335	0.169	0.222	0.169	NO	OK
GT-TC-E1844-20	B737	3/8/1996	force	0.390	0.081	0.268	0.081	NO	OK
IMAG-STBA-PIARC-22	B737	3/7/1996	torque	0.157	0.206	0.150	0.206	OK	OK
IMAG-STBA-PIARC-22	B737	3/7/1996	torque	0.157	0.233	0.150	0.233	OK	OK
IMAG-STBA-PIARC-22	B737	3/7/1996	torque	0.157	0.206	0.150	0.206	OK	OK
IMAG-STBA-PIARC-22	B737	3/7/1996	torque	0.145	0.187	0.138	0.187	NO	OK

IMAG-STBA-PIARC-22	B737	3/7/1996	torque	0.105	0.169	0.100	0.169	NO	OK
IMAG-STBA-PIARC-22	B737	3/8/1996	torque	0.355	0.081	0.337	0.081	NO	OK
RFT-FAA-E1551-30	B737	3/6/1996	force	0.435	0.225	0.292	0.225	OK	OK
RFT-FAA-E1551-30	B737	3/6/1996	force	0.435	0.233	0.292	0.233	OK	OK
RFT-FAA-E1551-30	B737	3/7/1996	force	0.293	0.206	0.177	0.206	OK	OK
RFT-FAA-E1551-30	B737	3/7/1996	force	0.293	0.233	0.177	0.233	OK	OK
RFT-FAA-E1551-30	B737	3/7/1996	force	0.293	0.206	0.177	0.206	OK	OK
RFT-FAA-E1551-30	B737	3/7/1996	force	0.360	0.187	0.232	0.187	OK	OK
RFT-FAA-E1551-30	B737	3/7/1996	force	0.320	0.169	0.199	0.169	OK	OK
RFT-FAA-E1551-30	B737	3/8/1996	force	0.210	0.081	0.111	0.081	OK	OK
RUNAR-NATAM-E1551-V-30	B737	3/6/1996	force	0.459	0.225	0.251	0.225	OK	OK
RUNAR-NATAM-E1551-V-30	B737	3/6/1996	force	0.459	0.233	0.251	0.233	OK	OK
RUNAR-NATAM-E1551-V-30	B737	3/7/1996	force	0.419	0.206	0.219	0.206	OK	OK
RUNAR-NATAM-E1551-V-30	B737	3/7/1996	force	0.419	0.233	0.219	0.233	OK	OK
RUNAR-NATAM-E1551-V-30	B737	3/7/1996	force	0.419	0.206	0.219	0.206	OK	OK
RUNAR-NATAM-E1551-V-30	B737	3/7/1996	force	0.390	0.187	0.195	0.187	NO	OK
RUNAR-NATAM-E1551-V-30	B737	3/7/1996	force	0.380	0.169	0.187	0.169	NO	OK
RUNAR-NATAM-E1551-V-30	B737	3/8/1996	force	0.685	0.081	0.433	0.081	NO	OK
SFT-TC85-E1551-30	B737	3/6/1996	torque	0.275	0.225	0.246	0.225	OK	OK
SFT-TC85-E1551-30	B737	3/6/1996	torque	0.275	0.233	0.246	0.233	OK	OK
SFT-TC85-E1551-30	B737	3/7/1996	torque	0.055	0.206	0.077	0.206	OK	OK
SFT-TC85-E1551-30	B737	3/7/1996	torque	0.055	0.233	0.077	0.233	OK	OK
SFT-TC85-E1551-30	B737	3/7/1996	torque	0.055	0.206	0.077	0.206	OK	OK
SFT-TC85-E1551-30	B737	3/7/1996	torque	0.190	0.187	0.181	0.187	OK	OK
SFT-TC85-E1551-30	B737	3/8/1996	torque	0.405	0.081	0.346	0.081	OK	OK
				G-F&T	B757	IRFI	B757		
ERD-BLAZER	B757	2/2/1999	force	0.329	0.155	0.332	0.155	OK	OK
ERD-BLAZER	B757	2/2/1999	force	0.329	0.181	0.332	0.181	OK	OK
ERD-BLAZER	B757	2/4/1999	force	0.355	0.166	0.347	0.166	OK	OK
ERD-BLAZER	B757	2/4/1999	force	0.355	0.18	0.347	0.180	OK	OK
ERD-BLAZER	B757	2/4/1999	force	0.355	0.183	0.347	0.183	OK	OK
ERD-BLAZER	B757	2/6/1999	force	0.300	0.141	0.315	0.141	OK	OK
ERD-BLAZER	B757	2/6/1999	force	0.300	0.153	0.315	0.153	OK	OK
ERD-BLAZER	B757	2/6/1999	force	0.300	0.164	0.315	0.164	OK	OK
ERD-BLAZER	B757	2/6/1999	force	0.305	0.142	0.318	0.142	OK	OK
ERD-BLAZER	B757	2/6/1999	force	0.305	0.158	0.318	0.158	OK	OK
ERD-BLAZER	B757	2/6/1999	force	0.305	0.171	0.318	0.171	OK	OK
ERD-BLAZER	B757	2/7/1999	force	0.270	0.138	0.298	0.138	OK	OK
ERD-BLAZER	B757	2/7/1999	force	0.270	0.169	0.298	0.169	OK	OK
ERD-BLAZER	B757	2/7/1999	force	0.270	0.172	0.298	0.172	OK	OK
IMAG-STBA-PIARC-22	B757	2/2/1999	force	0.317	0.155	0.302	0.155	OK	OK
IMAG-STBA-PIARC-22	B757	2/2/1999	force	0.317	0.181	0.302	0.181	OK	OK
IMAG-STBA-PIARC-22	B757	2/4/1999	force	0.345	0.166	0.328	0.166	OK	OK
IMAG-STBA-PIARC-22	B757	2/4/1999	force	0.345	0.18	0.328	0.180	OK	OK
IMAG-STBA-PIARC-22	B757	2/4/1999	force	0.345	0.183	0.328	0.183	OK	OK
IMAG-STBA-PIARC-22	B757	2/6/1999	force	0.295	0.141	0.280	0.141	OK	OK
IMAG-STBA-PIARC-22	B757	2/6/1999	force	0.295	0.153	0.280	0.153	OK	OK
IMAG-STBA-PIARC-22	B757	2/6/1999	force	0.295	0.164	0.280	0.164	OK	OK
ITTV-NASA-AC26-136	B757	2/6/1999	force	0.240	0.141	0.231	0.141	OK	OK
ITTV-NASA-AC26-136	B757	2/6/1999	force	0.240	0.153	0.237	0.153	OK	OK
ITTV-NASA-AC26-136	B757	2/6/1999	force	0.240	0.164	0.243	0.164	OK	OK
ITTV-NASA-AC26-136	B757	2/6/1999	force	0.240	0.142	0.232	0.142	OK	OK
ITTV-NASA-AC26-136	B757	2/6/1999	force	0.240	0.158	0.240	0.158	OK	OK
ITTV-NASA-AC26-136	B757	2/6/1999	force	0.240	0.171	0.247	0.171	OK	OK
ITTV-NASA-AC26-136	B757	2/7/1999	force	0.240	0.138	0.229	0.138	OK	OK
ITTV-NASA-AC26-136	B757	2/7/1999	force	0.240	0.169	0.246	0.169	OK	OK
ITTV-NASA-AC26-136	B757	2/7/1999	force	0.240	0.172	0.248	0.172	OK	OK
SFT-TC79-E1551-100	B757	2/2/1999	force	0.244	0.155	0.174	0.155	OK	OK
SFT-TC79-E1551-100	B757	2/2/1999	force	0.244	0.181	0.174	0.181	OK	OK

SFT-TC79-E1551-100	B757	2/4/1999	force	0.255	0.166	0.183	0.166	OK	OK
SFT-TC79-E1551-100	B757	2/4/1999	force	0.255	0.18	0.183	0.180	OK	OK
SFT-TC79-E1551-100	B757	2/4/1999	force	0.255	0.183	0.183	0.183	OK	OK
SFT-TC79-E1551-100	B757	2/6/1999	force	0.245	0.141	0.175	0.141	OK	OK
SFT-TC79-E1551-100	B757	2/6/1999	force	0.245	0.153	0.175	0.153	OK	OK
SFT-TC79-E1551-100	B757	2/6/1999	force	0.245	0.164	0.175	0.164	OK	OK
SFT-TC79-E1551-100	B757	2/6/1999	force	0.235	0.142	0.167	0.142	OK	OK
SFT-TC79-E1551-100	B757	2/6/1999	force	0.235	0.158	0.167	0.158	OK	OK
SFT-TC79-E1551-100	B757	2/6/1999	force	0.235	0.171	0.167	0.171	OK	OK
SFT-TC79-E1551-100	B757	2/7/1999	force	0.277	0.138	0.200	0.138	OK	OK
SFT-TC79-E1551-100	B757	2/7/1999	force	0.277	0.169	0.200	0.169	OK	OK
SFT-TC79-E1551-100	B757	2/7/1999	force	0.277	0.172	0.200	0.172	OK	OK
				G-F&T	DASH-8	IRFI	DASH-8		
ERD-BLAZER	DASH-8	3/3/1997	force	0.290	0.185		0.185	OK	OK
ERD-BLAZER	DASH-8	3/3/1997	force	0.290	0.194		0.194	OK	OK
ERD-BLAZER	DASH-8	3/3/1997	force	0.290	0.196		0.196	OK	OK
ERD-BLAZER	DASH-8	5/3/1997	force	0.350	0.213		0.213	OK	OK
ERD-BLAZER	DASH-8	5/3/1997	force	0.350	0.23		0.230	OK	OK
ERD-BLAZER	DASH-8	5/3/1997	force	0.350	0.239		0.239	OK	OK
ERD-BLAZER	DASH-8	5/3/1997	force	0.350	0.246		0.246	OK	OK
ERD-BLAZER	DASH-8	2/14/1998	force	0.220	0.196	0.269	0.196	OK	OK
ERD-BLAZER	DASH-8	2/14/1998	force	0.220	0.206	0.269	0.206	OK	OK
ERD-BLAZER	DASH-8	2/14/1998	force	0.220	0.203	0.269	0.203	OK	OK
ERD-BLAZER	DASH-8	2/14/1998	force	0.220	0.15	0.269	0.150	OK	OK
ERD-BLAZER	DASH-8	2/14/1998	force	0.220	0.158	0.269	0.158	OK	OK
ERD-BLAZER	DASH-8	2/15/1998	force	0.197	0.143	0.256	0.143	OK	OK
ERD-BLAZER	DASH-8	2/15/1998	force	0.197	0.133	0.256	0.133	OK	OK
ERD-BLAZER	DASH-8	2/15/1998	force	0.197	0.127	0.256	0.127	OK	OK
ERD-BLAZER	DASH-8	2/15/1998	force	0.197	0.146	0.256	0.146	OK	OK
ERD-BLAZER	DASH-8	2/15/1998	force	0.266	0.166	0.296	0.166	OK	OK
ERD-BLAZER	DASH-8	2/15/1998	force	0.266	0.155	0.296	0.155	OK	OK
ERD-BLAZER	DASH-8	2/15/1998	force	0.266	0.208	0.296	0.208	OK	OK
ERD-BLAZER	DASH-8	2/15/1998	force	0.266	0.19	0.296	0.190	OK	OK
SFT-TC79-E1551-100	DASH-8	2/14/1998	force	0.280	0.196	0.202	0.196	OK	OK
SFT-TC79-E1551-100	DASH-8	2/14/1998	force	0.280	0.206	0.202	0.206	OK	OK
SFT-TC79-E1551-100	DASH-8	2/14/1998	force	0.280	0.203	0.202	0.203	OK	OK
SFT-TC79-E1551-100	DASH-8	2/14/1998	force	0.280	0.15	0.202	0.150	OK	OK
SFT-TC79-E1551-100	DASH-8	2/14/1998	force	0.280	0.158	0.202	0.158	OK	OK
SFT-TC79-E1551-100	DASH-8	2/15/1998	force	0.285	0.143	0.206	0.143	OK	OK
SFT-TC79-E1551-100	DASH-8	2/15/1998	force	0.285	0.133	0.206	0.133	OK	OK
SFT-TC79-E1551-100	DASH-8	2/15/1998	force	0.285	0.127	0.206	0.127	OK	OK
SFT-TC79-E1551-100	DASH-8	2/15/1998	force	0.285	0.146	0.206	0.146	OK	OK
SFT-TC79-E1551-100	DASH-8	2/15/1998	force	0.370	0.166	0.272	0.166	OK	OK
SFT-TC79-E1551-100	DASH-8	2/15/1998	force	0.370	0.155	0.272	0.155	OK	OK
SFT-TC79-E1551-100	DASH-8	2/15/1998	force	0.370	0.208	0.272	0.208	OK	OK
SFT-TC79-E1551-100	DASH-8	2/15/1998	force	0.370	0.19	0.272	0.190	OK	OK
				G-F&T	FALCON-20	IRFI	FALCON-20		
ERD-BLAZER	FALCON-20	1/17/1996	force	0.560	0.295	0.538	0.295	NO	OK
ERD-BLAZER	FALCON-20	1/17/1996	force	0.560	0.307	0.538	0.307	NO	OK
ERD-BLAZER	FALCON-20	1/20/1996	force	0.365	0.245	0.321	0.245	OK	OK
ERD-BLAZER	FALCON-20	1/20/1996	force	0.365	0.222	0.321	0.222	OK	OK
ERD-BLAZER	FALCON-20	1/20/1996	force	0.365	0.216	0.321	0.216	OK	OK
ERD-BLAZER	FALCON-20	1/20/1996	force	0.365	0.212	0.321	0.212	OK	OK
ERD-BLAZER	FALCON-20	1/20/1996	force	0.740	0.401	0.739	0.401	OK	OK
ERD-BLAZER	FALCON-20	1/20/1996	force	0.740	0.374	0.739	0.374	OK	OK
ERD-BLAZER	FALCON-20	1/20/1996	force	0.740	0.372	0.739	0.372	OK	OK
ERD-BLAZER	FALCON-20	1/21/1996	force	0.355	0.178	0.310	0.178	OK	OK
ERD-BLAZER	FALCON-20	1/21/1996	force	0.355	0.151	0.310	0.151	OK	OK
ERD-BLAZER	FALCON-20	1/21/1996	force	0.355	0.162	0.310	0.162	OK	OK

ERD-BLAZER	FALCON-20	1/21/1996	force	0.355	0.164	0.310	0.164	OK	OK
ERD-BLAZER	FALCON-20	1/21/1996	force	0.377	0.172	0.334	0.172	NO	OK
ERD-BLAZER	FALCON-20	1/21/1996	force	0.377	0.117	0.334	0.117	NO	OK
ERD-BLAZER	FALCON-20	1/21/1996	force	0.377	0.157	0.334	0.157	NO	OK
ERD-BLAZER	FALCON-20	1/21/1996	force	0.377	0.101	0.334	0.101	NO	OK
ERD-BLAZER	FALCON-20	1/24/1996	force	0.570	0.292	0.549	0.292	NO	OK
ERD-BLAZER	FALCON-20	1/24/1996	force	0.570	0.319	0.549	0.319	NO	OK
ERD-BLAZER	FALCON-20	1/24/1996	force	0.570	0.33	0.549	0.330	NO	OK
ERD-BLAZER	FALCON-20	1/24/1996	force	0.277	0.14	0.222	0.140	NO	OK
ERD-BLAZER	FALCON-20	1/24/1996	force	0.277	0.099	0.222	0.099	NO	OK
ERD-BLAZER	FALCON-20	1/24/1996	force	0.277	0.13	0.222	0.130	NO	OK
ERD-BLAZER	FALCON-20	1/24/1996	force	0.277	0.103	0.222	0.103	NO	OK
ERD-BLAZER	FALCON-20	1/25/1996	force	0.280	0.167	0.226	0.167	NO	OK
ERD-BLAZER	FALCON-20	1/25/1996	force	0.280	0.187	0.226	0.187	NO	OK
ERD-BLAZER	FALCON-20	1/25/1996	force	0.280	0.155	0.226	0.155	NO	OK
ERD-BLAZER	FALCON-20	1/25/1996	force	0.280	0.203	0.226	0.203	NO	OK
ERD-BLAZER	FALCON-20	1/25/1996	force	0.205	0.14	0.143	0.140	NO	OK
ERD-BLAZER	FALCON-20	1/25/1996	force	0.205	0.133	0.143	0.133	OK	OK
ERD-BLAZER	FALCON-20	1/25/1996	force	0.205	0.114	0.143	0.114	OK	OK
ERD-BLAZER	FALCON-20	1/25/1996	force	0.205	0.109	0.143	0.109	OK	OK
ERD-BLAZER	FALCON-20	1/25/1996	force	0.245	0.174	0.187	0.174	OK	OK
ERD-BLAZER	FALCON-20	1/25/1996	force	0.245	0.18	0.187	0.180	OK	OK
ERD-BLAZER	FALCON-20	1/25/1996	force	0.245	0.166	0.187	0.166	OK	OK
ERD-BLAZER	FALCON-20	1/25/1996	force	0.245	0.157	0.187	0.157	OK	OK
ERD-BLAZER	FALCON-20	3/4/1996	force	0.480	0.257	0.449	0.257	NO	OK
ERD-BLAZER	FALCON-20	3/4/1996	force	0.480	0.198	0.449	0.198	NO	OK
ERD-BLAZER	FALCON-20	3/4/1996	force	0.480	0.227	0.449	0.227	NO	OK
ERD-BLAZER	FALCON-20	3/6/1996	force	0.370	0.236	0.326	0.236	OK	OK
ERD-BLAZER	FALCON-20	3/6/1996	force	0.370	0.201	0.326	0.201	OK	OK
ERD-BLAZER	FALCON-20	3/6/1996	force	0.370	0.214	0.326	0.214	OK	OK
ERD-BLAZER	FALCON-20	3/6/1996	force	0.370	0.206	0.326	0.206	OK	OK
ERD-BLAZER	FALCON-20	3/7/1996	force	0.313	0.166	0.263	0.166	NO	OK
ERD-BLAZER	FALCON-20	3/7/1996	force	0.313	0.123	0.263	0.123	NO	OK
ERD-BLAZER	FALCON-20	3/7/1996	force	0.313	0.134	0.263	0.134	NO	OK
ERD-BLAZER	FALCON-20	3/7/1996	force	0.313	0.122	0.263	0.122	NO	OK
ERD-BLAZER	FALCON-20	3/7/1996	force	0.360	0.192	0.315	0.192	NO	OK
GT-TC-E1844-20	FALCON-20	1/17/1996	force	0.585	0.295	0.430	0.295	NO	OK
GT-TC-E1844-20	FALCON-20	1/17/1996	force	0.585	0.307	0.430	0.307	NO	OK
GT-TC-E1844-20	FALCON-20	1/20/1996	force	0.328	0.245	0.216	0.245	OK	OK
GT-TC-E1844-20	FALCON-20	1/20/1996	force	0.328	0.222	0.216	0.222	OK	OK
GT-TC-E1844-20	FALCON-20	1/20/1996	force	0.328	0.216	0.216	0.216	OK	OK
GT-TC-E1844-20	FALCON-20	1/20/1996	force	0.328	0.212	0.216	0.212	OK	OK
GT-TC-E1844-20	FALCON-20	1/20/1996	force	0.930	0.401	0.716	0.401	OK	OK
GT-TC-E1844-20	FALCON-20	1/20/1996	force	0.930	0.374	0.716	0.374	OK	OK
GT-TC-E1844-20	FALCON-20	1/20/1996	force	0.930	0.372	0.716	0.372	OK	OK
GT-TC-E1844-20	FALCON-20	1/21/1996	force	0.281	0.178	0.178	0.178	OK	OK
GT-TC-E1844-20	FALCON-20	1/21/1996	force	0.281	0.151	0.178	0.151	OK	OK
GT-TC-E1844-20	FALCON-20	1/21/1996	force	0.281	0.162	0.178	0.162	OK	OK
GT-TC-E1844-20	FALCON-20	1/21/1996	force	0.281	0.164	0.178	0.164	OK	OK
GT-TC-E1844-20	FALCON-20	1/21/1996	force	0.345	0.172	0.230	0.172	NO	OK
GT-TC-E1844-20	FALCON-20	1/21/1996	force	0.345	0.117	0.230	0.117	NO	OK
GT-TC-E1844-20	FALCON-20	1/21/1996	force	0.345	0.157	0.230	0.157	NO	OK
GT-TC-E1844-20	FALCON-20	1/21/1996	force	0.345	0.101	0.230	0.101	NO	OK
GT-TC-E1844-20	FALCON-20	1/24/1996	force	0.913	0.292	0.702	0.292	NO	OK
GT-TC-E1844-20	FALCON-20	1/24/1996	force	0.913	0.319	0.702	0.319	NO	OK
GT-TC-E1844-20	FALCON-20	1/24/1996	force	0.913	0.33	0.702	0.330	NO	OK
GT-TC-E1844-20	FALCON-20	1/24/1996	force	0.370	0.14	0.251	0.140	NO	OK
GT-TC-E1844-20	FALCON-20	1/24/1996	force	0.370	0.099	0.251	0.099	NO	OK
GT-TC-E1844-20	FALCON-20	1/24/1996	force	0.370	0.13	0.251	0.130	NO	OK

GT-TC-E1844-20	FALCON-20	1/24/1996	force	0.370	0.103	0.251	0.103	NO	OK
GT-TC-E1844-20	FALCON-20	1/25/1996	force	0.320	0.167	0.210	0.167	NO	OK
GT-TC-E1844-20	FALCON-20	1/25/1996	force	0.320	0.187	0.210	0.187	NO	OK
GT-TC-E1844-20	FALCON-20	1/25/1996	force	0.320	0.155	0.210	0.155	NO	OK
GT-TC-E1844-20	FALCON-20	1/25/1996	force	0.320	0.203	0.210	0.203	NO	OK
GT-TC-E1844-20	FALCON-20	1/25/1996	force	0.305	0.14	0.197	0.140	OK	OK
GT-TC-E1844-20	FALCON-20	1/25/1996	force	0.305	0.133	0.197	0.133	OK	OK
GT-TC-E1844-20	FALCON-20	1/25/1996	force	0.305	0.114	0.197	0.114	OK	OK
GT-TC-E1844-20	FALCON-20	1/25/1996	force	0.305	0.109	0.197	0.109	OK	OK
GT-TC-E1844-20	FALCON-20	1/25/1996	force	0.300	0.174	0.193	0.174	OK	OK
GT-TC-E1844-20	FALCON-20	1/25/1996	force	0.300	0.18	0.193	0.180	OK	OK
GT-TC-E1844-20	FALCON-20	1/25/1996	force	0.300	0.166	0.193	0.166	OK	OK
GT-TC-E1844-20	FALCON-20	1/25/1996	force	0.300	0.157	0.193	0.157	OK	OK
GT-TC-E1844-20	FALCON-20	3/6/1996	force	0.293	0.236	0.187	0.236	OK	OK
GT-TC-E1844-20	FALCON-20	3/6/1996	force	0.293	0.201	0.187	0.201	OK	OK
GT-TC-E1844-20	FALCON-20	3/6/1996	force	0.293	0.214	0.187	0.214	OK	OK
GT-TC-E1844-20	FALCON-20	3/6/1996	force	0.293	0.206	0.187	0.206	OK	OK
GT-TC-E1844-20	FALCON-20	3/7/1996	force	0.417	0.166	0.291	0.166	NO	OK
GT-TC-E1844-20	FALCON-20	3/7/1996	force	0.417	0.123	0.291	0.123	NO	OK
GT-TC-E1844-20	FALCON-20	3/7/1996	force	0.417	0.134	0.291	0.134	NO	OK
GT-TC-E1844-20	FALCON-20	3/7/1996	force	0.417	0.122	0.291	0.122	NO	OK
GT-TC-E1844-20	FALCON-20	3/7/1996	force	0.335	0.192	0.222	0.192	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	3/6/1996	torque	0.190	0.236	0.181	0.236	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	3/6/1996	torque	0.190	0.201	0.181	0.201	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	3/6/1996	torque	0.190	0.214	0.181	0.214	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	3/6/1996	torque	0.190	0.206	0.181	0.206	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	3/7/1996	torque	0.157	0.166	0.150	0.166	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	3/7/1996	torque	0.157	0.123	0.150	0.123	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	3/7/1996	torque	0.157	0.134	0.150	0.134	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	3/7/1996	torque	0.157	0.122	0.150	0.122	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	3/7/1996	torque	0.105	0.192	0.100	0.192	NO	OK
RFT-FAA-E1551-30	FALCON-20	3/6/1996	force	0.418	0.236	0.278	0.236	OK	OK
RFT-FAA-E1551-30	FALCON-20	3/6/1996	force	0.418	0.201	0.278	0.201	OK	OK
RFT-FAA-E1551-30	FALCON-20	3/6/1996	force	0.418	0.214	0.278	0.214	OK	OK
RFT-FAA-E1551-30	FALCON-20	3/6/1996	force	0.418	0.206	0.278	0.206	OK	OK
RFT-FAA-E1551-30	FALCON-20	3/7/1996	force	0.293	0.166	0.177	0.166	NO	OK
RFT-FAA-E1551-30	FALCON-20	3/7/1996	force	0.293	0.123	0.177	0.123	NO	OK
RFT-FAA-E1551-30	FALCON-20	3/7/1996	force	0.293	0.134	0.177	0.134	NO	OK
RFT-FAA-E1551-30	FALCON-20	3/7/1996	force	0.293	0.122	0.177	0.122	NO	OK
RFT-FAA-E1551-30	FALCON-20	3/7/1996	force	0.320	0.192	0.199	0.192	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/20/1996	force	0.487	0.245	0.334	0.245	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/20/1996	force	0.487	0.222	0.274	0.222	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/20/1996	force	0.487	0.216	0.274	0.216	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/20/1996	force	0.487	0.212	0.274	0.212	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/20/1996	force	1.120	0.401	0.784	0.401	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/20/1996	force	1.120	0.374	0.784	0.374	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/20/1996	force	1.120	0.372	0.784	0.372	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/21/1996	force	0.394	0.178	0.198	0.178	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/21/1996	force	0.394	0.151	0.198	0.151	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/21/1996	force	0.394	0.162	0.198	0.162	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/21/1996	force	0.394	0.164	0.198	0.164	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/21/1996	force	0.385	0.172	0.191	0.172	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/21/1996	force	0.385	0.117	0.191	0.117	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/21/1996	force	0.385	0.157	0.191	0.157	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/21/1996	force	0.385	0.101	0.191	0.101	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/24/1996	force	1.093	0.292	0.761	0.292	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/24/1996	force	1.093	0.319	0.761	0.319	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/24/1996	force	1.093	0.33	0.761	0.330	NO	OK
GT-TC-E1844-20	FALCON-20	1/24/1996	force	0.637	0.2324392	0.473	0.232	NO	OK

RUNAR-NATAM-E1551-V-30	FALCON-20	1/24/1996	force	0.395	0.099	0.199	0.099	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/24/1996	force	0.395	0.13	0.199	0.130	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/24/1996	force	0.395	0.103	0.199	0.103	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/25/1996	force	0.330	0.167	0.147	0.167	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/25/1996	force	0.330	0.187	0.147	0.187	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/25/1996	force	0.330	0.155	0.147	0.155	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/25/1996	force	0.330	0.203	0.147	0.203	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/25/1996	force	0.400	0.14	0.203	0.140	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/25/1996	force	0.400	0.133	0.203	0.133	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/25/1996	force	0.400	0.114	0.203	0.114	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/25/1996	force	0.400	0.109	0.203	0.109	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/25/1996	force	0.475	0.174	0.264	0.174	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/25/1996	force	0.475	0.18	0.264	0.180	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/25/1996	force	0.475	0.166	0.264	0.166	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/25/1996	force	0.475	0.157	0.264	0.157	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	3/6/1996	force	0.535	0.236	0.312	0.236	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	3/6/1996	force	0.535	0.201	0.312	0.201	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	3/6/1996	force	0.535	0.214	0.312	0.214	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	3/6/1996	force	0.535	0.206	0.312	0.206	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	3/7/1996	force	0.419	0.166	0.219	0.166	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	3/7/1996	force	0.419	0.123	0.219	0.123	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	3/7/1996	force	0.419	0.134	0.219	0.134	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	3/7/1996	force	0.419	0.122	0.219	0.122	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	3/7/1996	force	0.380	0.192	0.187	0.192	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/17/1996	torque	0.695	0.295	0.568	0.295	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/17/1996	torque	0.695	0.307	0.568	0.307	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/20/1996	torque	0.302	0.245	0.267	0.245	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/20/1996	torque	0.302	0.222	0.267	0.222	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/20/1996	torque	0.302	0.216	0.267	0.216	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/20/1996	torque	0.302	0.212	0.267	0.212	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/20/1996	torque	0.960	0.401	0.771	0.401	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/20/1996	torque	0.960	0.374	0.771	0.374	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/20/1996	torque	0.960	0.372	0.771	0.372	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/21/1996	torque	0.115	0.178	0.123	0.178	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/21/1996	torque	0.115	0.151	0.123	0.151	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/21/1996	torque	0.115	0.162	0.123	0.162	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/21/1996	torque	0.115	0.164	0.123	0.164	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/21/1996	torque	0.055	0.172	0.077	0.172	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/21/1996	torque	0.055	0.117	0.077	0.117	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/21/1996	torque	0.055	0.157	0.077	0.157	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/21/1996	torque	0.055	0.101	0.077	0.101	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/24/1996	torque	0.912	0.292	0.734	0.292	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/24/1996	torque	0.912	0.319	0.734	0.319	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/24/1996	torque	0.912	0.33	0.734	0.330	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/24/1996	torque	0.045	0.14	0.070	0.140	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/24/1996	torque	0.045	0.099	0.070	0.099	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/24/1996	torque	0.045	0.13	0.070	0.130	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/24/1996	torque	0.045	0.103	0.070	0.103	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/25/1996	torque	0.233	0.167	0.214	0.167	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/25/1996	torque	0.233	0.187	0.214	0.187	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/25/1996	torque	0.233	0.155	0.214	0.155	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/25/1996	torque	0.233	0.203	0.214	0.203	NO	OK
SFT-TC85-E1551-30	FALCON-20	1/25/1996	torque	0.245	0.14	0.223	0.140	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/25/1996	torque	0.245	0.133	0.223	0.133	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/25/1996	torque	0.245	0.114	0.223	0.114	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/25/1996	torque	0.245	0.109	0.223	0.109	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/25/1996	torque	0.275	0.174	0.246	0.174	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/25/1996	torque	0.275	0.18	0.246	0.180	OK	OK
SFT-TC85-E1551-30	FALCON-20	1/25/1996	torque	0.275	0.166	0.246	0.166	OK	OK

SFT-TC85-E1551-30	FALCON-20	1/25/1996	torque	0.275	0.157	0.246	0.157	OK	OK
SFT-TC85-E1551-30	FALCON-20	3/6/1996	torque	0.253	0.236	0.229	0.236	OK	OK
SFT-TC85-E1551-30	FALCON-20	3/6/1996	torque	0.253	0.201	0.229	0.201	OK	OK
SFT-TC85-E1551-30	FALCON-20	3/6/1996	torque	0.253	0.214	0.229	0.214	OK	OK
SFT-TC85-E1551-30	FALCON-20	3/6/1996	torque	0.253	0.206	0.229	0.206	OK	OK
SFT-TC85-E1551-30	FALCON-20	3/7/1996	torque	0.055	0.166	0.077	0.166	NO	OK
SFT-TC85-E1551-30	FALCON-20	3/7/1996	torque	0.055	0.123	0.077	0.123	NO	OK
SFT-TC85-E1551-30	FALCON-20	3/7/1996	torque	0.055	0.134	0.077	0.134	NO	OK
SFT-TC85-E1551-30	FALCON-20	3/7/1996	torque	0.055	0.122	0.077	0.122	NO	OK
ERD-BLAZER	FALCON-20	1/23/1997	force	0.487	0.37		0.370	NO	OK
ERD-BLAZER	FALCON-20	1/23/1997	force	0.487	0.376		0.376	NO	OK
ERD-BLAZER	FALCON-20	1/23/1997	force	0.487	0.377		0.377	NO	OK
ERD-BLAZER	FALCON-20	1/23/1997	force	0.487	0.372		0.372	NO	OK
ERD-BLAZER	FALCON-20	1/23/1997	force	0.487	0.414		0.414	NO	OK
ERD-BLAZER	FALCON-20	1/24/1997	force	0.357	0.1		0.100	NO	OK
ERD-BLAZER	FALCON-20	1/24/1997	force	0.357	0.104		0.104	NO	OK
ERD-BLAZER	FALCON-20	1/26/1997	force	0.280	0.152		0.152	OK	OK
ERD-BLAZER	FALCON-20	1/26/1997	force	0.280	0.128		0.128	OK	OK
GRT-DND-STD	FALCON-20	1/23/1997	force	0.870	0.37	0.089	0.370	NO	OK
GRT-DND-STD	FALCON-20	1/23/1997	force	0.870	0.376	0.089	0.376	NO	OK
GRT-DND-STD	FALCON-20	1/23/1997	force	0.870	0.377	0.089	0.377	NO	OK
GRT-DND-STD	FALCON-20	1/23/1997	force	0.870	0.372	0.089	0.372	NO	OK
GRT-DND-STD	FALCON-20	1/23/1997	force	0.870	0.414	0.089	0.414	NO	OK
GT-TC-E1844-20	FALCON-20	1/24/1997	force	0.350	0.1	0.131	0.100	NO	OK
GT-TC-E1844-20	FALCON-20	1/24/1997	force	0.350	0.104	0.131	0.104	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/26/1997	torque	0.120	0.152	0.114	0.152	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/26/1997	torque	0.120	0.128	0.114	0.128	OK	OK
RFT-FAA-E1551-30	FALCON-20	1/23/1997	force	0.980	0.37	0.539	0.370	NO	OK
RFT-FAA-E1551-30	FALCON-20	1/23/1997	force	0.980	0.376	0.539	0.376	NO	OK
RFT-FAA-E1551-30	FALCON-20	1/23/1997	force	0.980	0.377	0.539	0.377	NO	OK
RFT-FAA-E1551-30	FALCON-20	1/23/1997	force	0.980	0.372	0.539	0.372	NO	OK
RFT-FAA-E1551-30	FALCON-20	1/23/1997	force	0.980	0.414	0.539	0.414	NO	OK
RFT-FAA-E1551-30	FALCON-20	1/24/1997	force	0.318	0.1	0.200	0.100	NO	OK
RFT-FAA-E1551-30	FALCON-20	1/24/1997	force	0.318	0.104	0.200	0.104	NO	OK
RFT-FAA-E1551-30	FALCON-20	1/26/1997	force	0.300	0.152	0.191	0.152	OK	OK
RFT-FAA-E1551-30	FALCON-20	1/26/1997	force	0.300	0.128	0.191	0.128	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/23/1997	force	0.955	0.37	0.499	0.370	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/23/1997	force	0.955	0.376	0.499	0.376	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/23/1997	force	0.955	0.377	0.499	0.377	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/23/1997	force	0.955	0.372	0.499	0.372	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/23/1997	force	0.955	0.414	0.499	0.414	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/24/1997	force	0.315	0.1	0.185	0.100	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/24/1997	force	0.315	0.104	0.185	0.104	NO	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/26/1997	force	0.260	0.152	0.159	0.152	OK	OK
RUNAR-NATAM-E1551-V-30	FALCON-20	1/26/1997	force	0.260	0.128	0.159	0.128	OK	OK
SFT-212-E1551-30	FALCON-20	1/23/1997	torque	0.880	0.37	0.672	0.370	NO	OK
SFT-212-E1551-30	FALCON-20	1/23/1997	torque	0.880	0.376	0.672	0.376	NO	OK
SFT-212-E1551-30	FALCON-20	1/23/1997	torque	0.880	0.377	0.672	0.377	NO	OK
SFT-212-E1551-30	FALCON-20	1/23/1997	torque	0.880	0.372	0.672	0.372	NO	OK
SFT-212-E1551-30	FALCON-20	1/23/1997	torque	0.880	0.414	0.672	0.414	NO	OK
SFT-212-E1551-30	FALCON-20	1/26/1997	torque	0.190	0.152	0.155	0.152	OK	OK
SFT-212-E1551-30	FALCON-20	1/26/1997	torque	0.190	0.128	0.155	0.128	OK	OK
SFT-99-AERO-100	FALCON-20	1/23/1997	torque	0.630	0.37	0.452	0.370	NO	OK
SFT-99-AERO-100	FALCON-20	1/23/1997	torque	0.630	0.376	0.452	0.376	NO	OK
SFT-99-AERO-100	FALCON-20	1/23/1997	torque	0.630	0.377	0.452	0.377	NO	OK
SFT-99-AERO-100	FALCON-20	1/23/1997	torque	0.630	0.372	0.452	0.372	NO	OK
SFT-99-AERO-100	FALCON-20	1/23/1997	torque	0.630	0.414	0.452	0.414	NO	OK
SFT-99-AERO-100	FALCON-20	1/26/1997	torque	0.070	0.152	0.057	0.152	OK	OK
SFT-99-AERO-100	FALCON-20	1/26/1997	torque	0.070	0.128	0.057	0.128	OK	OK

SFT-TC79-E1551RIB-30	FALCON-20	1/23/1997	torque	0.810	0.37	0.560	0.370	NO	OK
SFT-TC79-E1551RIB-30	FALCON-20	1/23/1997	torque	0.810	0.376	0.560	0.376	NO	OK
SFT-TC79-E1551RIB-30	FALCON-20	1/23/1997	torque	0.810	0.377	0.560	0.377	NO	OK
SFT-TC79-E1551RIB-30	FALCON-20	1/23/1997	torque	0.810	0.372	0.560	0.372	NO	OK
SFT-TC79-E1551RIB-30	FALCON-20	1/23/1997	torque	0.810	0.414	0.560	0.414	NO	OK
SFT-TC79-E1551RIB-30	FALCON-20	1/26/1997	torque	0.140	0.152	0.109	0.152	OK	OK
SFT-TC79-E1551RIB-30	FALCON-20	1/26/1997	torque	0.140	0.128	0.109	0.128	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/24/1997	torque	0.050	0.1		0.100	NO	Yes
IMAG-STBA-PIARC-22	FALCON-20	1/24/1997	torque	0.050	0.104		0.104	NO	Yes
SFT-TC79-E1551RIB-30	FALCON-20	1/24/1997	torque	0.060	0.1		0.100	NO	Yes
SFT-TC79-E1551RIB-30	FALCON-20	1/24/1997	torque	0.060	0.104		0.104	NO	Yes
SFT-212-E1551-30	FALCON-20	1/24/1997	torque	0.065	0.1		0.100	NO	Yes
SFT-212-E1551-30	FALCON-20	1/24/1997	torque	0.065	0.104		0.104	NO	Yes
GT-TC-E1844-20	FALCON-20	1/23/1997	force	0.875	0.37	0.875	0.370	NO	Yes
GT-TC-E1844-20	FALCON-20	1/23/1997	force	0.875	0.376	0.875	0.376	NO	Yes
GT-TC-E1844-20	FALCON-20	1/23/1997	force	0.875	0.377	0.875	0.377	NO	Yes
GT-TC-E1844-20	FALCON-20	1/23/1997	force	0.875	0.372	0.875	0.372	NO	Yes
GT-TC-E1844-20	FALCON-20	1/23/1997	force	0.875	0.414	0.875	0.414	NO	Yes
ERD-23	FALCON-20	1/28/1998	force	0.220	0.151	0.270	0.151	OK	OK
ERD-23	FALCON-20	1/28/1998	force	0.220	0.147	0.270	0.147	OK	OK
ERD-BLAZER	FALCON-20	1/21/1998	force	0.510	0.326	0.437	0.326	NO	OK
ERD-BLAZER	FALCON-20	1/21/1998	force	0.510	0.285	0.437	0.285	NO	OK
ERD-BLAZER	FALCON-20	1/21/1998	force	0.510	0.338	0.437	0.338	NO	OK
ERD-BLAZER	FALCON-20	1/21/1998	force	0.510	0.28	0.437	0.280	NO	OK
ERD-BLAZER	FALCON-20	1/26/1998	force	0.290	0.141	0.310	0.141	OK	OK
ERD-BLAZER	FALCON-20	1/26/1998	force	0.290	0.203	0.310	0.203	OK	OK
ERD-BLAZER	FALCON-20	1/26/1998	force	0.290	0.156	0.310	0.156	OK	OK
ERD-BLAZER	FALCON-20	1/26/1998	force	0.290	0.214	0.310	0.214	OK	OK
ERD-BLAZER	FALCON-20	1/26/1998	force	0.290	0.174	0.310	0.174	OK	OK
ERD-BLAZER	FALCON-20	1/29/1998	force	**0.445**	0.238	0.400	0.238	NO	OK
ERD-BLAZER	FALCON-20	1/29/1998	force	0.445	0.263	0.400	0.263	NO	OK
ERD-BLAZER	FALCON-20	1/29/1998	force	0.445	0.24	0.400	0.240	NO	OK
ERD-BLAZER	FALCON-20	1/29/1998	force	**0.445**	0.281	0.400	0.281	NO	OK
ERD-BLAZER	FALCON-20	1/30/1998	force	0.280	0.186	0.304	0.186	OK	OK
ERD-BLAZER	FALCON-20	1/30/1998	force	0.280	0.139	0.304	0.139	OK	OK
ERD-BLAZER	FALCON-20	1/30/1998	force	0.280	0.185	0.304	0.185	OK	OK
ERD-BLAZER	FALCON-20	1/30/1998	force	0.280	0.202	0.304	0.202	OK	OK
ERD-BLAZER	FALCON-20	2/13/1998	force	0.245	0.124	0.283	0.124	OK	OK
ERD-BLAZER	FALCON-20	2/13/1998	force	0.245	0.137	0.283	0.137	OK	OK
ERD-BLAZER	FALCON-20	2/13/1998	force	0.245	0.156	0.283	0.156	OK	OK
ERD-BLAZER	FALCON-20	2/13/1998	force	0.245	0.203	0.283	0.203	OK	OK
ERD-BLAZER	FALCON-20	2/13/1998	force	0.245	0.162	0.283	0.162	OK	OK
ERD-BLAZER	FALCON-20	2/13/1998	force	0.245	0.208	0.283	0.208	OK	OK
ERD-BLAZER	FALCON-20	3/3/1998	force	0.530	0.299	0.449	0.299	OK	OK
ERD-BLAZER	FALCON-20	3/3/1998	force	0.530	0.267	0.449	0.267	OK	OK
ERD-BLAZER	FALCON-20	3/4/1998	force	0.550	0.281	0.461	0.281	OK	OK
ERD-BLAZER	FALCON-20	3/4/1998	force	0.440	0.123	0.397	0.123	OK	OK
ERD-BLAZER	FALCON-20	3/4/1998	force	0.440	0.122	0.397	0.122	OK	OK
ERD-BLAZER	FALCON-20	3/4/1998	force	0.440	0.149	0.397	0.149	OK	OK
ERD-BLAZER	FALCON-20	3/4/1998	force	0.440	0.147	0.397	0.147	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/28/1998	force	0.197	0.151	0.187	0.151	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/28/1998	force	0.197	0.147	0.187	0.147	OK	OK
ITTV-NASA-AC26-136	FALCON-20	1/28/1998	force	0.198	0.151	0.188	0.151	OK	OK
ITTV-NASA-AC26-136	FALCON-20	1/28/1998	force	0.198	0.147	0.188	0.147	OK	OK
SFT-TC79-E1551-100	FALCON-20	2/13/1998	force	0.290	0.124	0.210	0.124	OK	OK
SFT-TC79-E1551-100	FALCON-20	2/13/1998	force	0.290	0.137	0.210	0.137	OK	OK
SFT-TC79-E1551-100	FALCON-20	2/13/1998	force	0.290	0.156	0.210	0.156	OK	OK
SFT-TC79-E1551-100	FALCON-20	2/13/1998	force	0.290	0.203	0.210	0.203	OK	OK
SFT-TC79-E1551-100	FALCON-20	2/13/1998	force	0.290	0.162	0.210	0.162	OK	OK

SFT-TC79-E1551-100	FALCON-20	2/13/1998	force	0.290	0.208	0.210	0.208	OK	OK
SFT-TC79-E1551-100	FALCON-20	3/3/1998	force	0.750	0.299	0.567	0.299	OK	OK
SFT-TC79-E1551-100	FALCON-20	3/3/1998	force	0.750	0.267	0.567	0.267	OK	OK
SFT-TC79-E1551-100	FALCON-20	3/4/1998	force	0.520	0.123	0.389	0.123	OK	OK
SFT-TC79-E1551-100	FALCON-20	3/4/1998	force	0.520	0.122	0.389	0.122	OK	OK
SFT-TC79-E1551-100	FALCON-20	3/4/1998	force	0.520	0.149	0.389	0.149	OK	OK
SFT-TC79-E1551-100	FALCON-20	3/4/1998	force	0.520	0.147	0.389	0.147	OK	OK
ERD-BLAZER	FALCON-20	1/25/1999	force	0.810	0.457	0.612	0.457	OK	OK
ERD-BLAZER	FALCON-20	1/28/1999	force	0.365	0.179	0.353	0.179	NO	OK
ERD-BLAZER	FALCON-20	1/28/1999	force	0.365	0.191	0.353	0.191	NO	OK
ERD-BLAZER	FALCON-20	1/28/1999	force	0.365	0.186	0.353	0.186	NO	OK
ERD-BLAZER	FALCON-20	1/28/1999	force	0.365	0.216	0.353	0.216	NO	OK
ERD-BLAZER	FALCON-20	1/28/1999	force	0.365	0.267	0.353	0.267	NO	OK
ERD-BLAZER	FALCON-20	1/28/1999	force	0.324	0.197	0.329	0.197	NO	OK
ERD-BLAZER	FALCON-20	1/28/1999	force	0.324	0.215	0.329	0.215	NO	OK
ERD-BLAZER	FALCON-20	1/28/1999	force	0.324	0.266	0.329	0.266	NO	OK
ERD-BLAZER	FALCON-20	1/28/1999	force	0.324	0.213	0.329	0.213	NO	OK
ERD-BLAZER	FALCON-20	1/28/1999	force	0.324	0.221	0.329	0.221	NO	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	0.300	0.144	0.315	0.144	OK	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	0.300	0.193	0.315	0.193	OK	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	**0.300**	0.203	0.315	0.203	OK	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	0.300	0.226	0.315	0.226	OK	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	0.300	0.181	0.315	0.181	OK	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	0.300	0.25	0.315	0.250	OK	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	0.300	0.199	0.315	0.199	OK	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	0.19	0.105	0.251	0.105	OK	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	0.18	0.111	0.246	0.111	OK	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	0.20	0.112	0.257	0.112	OK	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	0.17	0.115	0.240	0.115	OK	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	0.16	0.114	0.234	0.114	OK	OK
ERD-BLAZER	FALCON-20	1/29/1999	force	0.19	0.106	0.251	0.106	OK	OK
ERD-BLAZER	FALCON-20	3/9/1999	force	0.14	0.073	0.222	0.073	OK	OK
ERD-BLAZER	FALCON-20	3/9/1999	force	0.14	0.07	0.222	0.070	OK	OK
ERD-BLAZER	FALCON-20	3/9/1999	force	0.17	0.108	0.240	0.108	OK	OK
ERD-BLAZER	FALCON-20	3/9/1999	force	0.22	0.123	0.269	0.123	OK	OK
ERD-BLAZER	FALCON-20	3/9/1999	force	0.22	0.131	0.269	0.131	OK	OK
ERD-BLAZER	FALCON-20	3/9/1999	force	0.22	0.126	0.269	0.126	OK	OK
ERD-BLAZER	FALCON-20	3/9/1999	force	0.21	0.125	0.263	0.125	OK	OK
ERD-BLAZER	FALCON-20	3/9/1999	force	0.22	0.117	0.269	0.117	OK	OK
ERD-BLAZER	FALCON-20	3/23/1999	force	0.25	0.182	0.286	0.182	NO	OK
ERD-BLAZER	FALCON-20	3/23/1999	force	0.22	0.154	0.269	0.154	OK	OK
ERD-BLAZER	FALCON-20	3/23/1999	force	0.22	0.159	0.269	0.159	OK	OK
ERD-BLAZER	FALCON-20	3/23/1999	force	0.22	0.145	0.269	0.145	OK	OK
ERD-BLAZER	FALCON-20	3/23/1999	force	0.21	0.162	0.263	0.162	OK	OK
GRT-DND-E1844-20	FALCON-20	1/28/1999	force	0.625	0.179	0.665	0.179	NO	OK
GRT-DND-E1844-20	FALCON-20	1/28/1999	force	0.625	0.191	0.665	0.191	NO	OK
GRT-DND-E1844-20	FALCON-20	1/28/1999	force	0.625	0.186	0.665	0.186	NO	OK
GRT-DND-E1844-20	FALCON-20	1/28/1999	force	0.625	0.216	0.665	0.216	NO	OK
GRT-DND-E1844-20	FALCON-20	1/28/1999	force	0.625	0.267	0.665	0.267	NO	OK
GRT-DND-E1844-20	FALCON-20	1/28/1999	force	0.464	0.197	0.497	0.197	NO	OK
GRT-DND-E1844-20	FALCON-20	1/28/1999	force	0.464	0.215	0.497	0.215	NO	OK
GRT-DND-E1844-20	FALCON-20	1/28/1999	force	0.464	0.266	0.497	0.266	NO	OK
GRT-DND-E1844-20	FALCON-20	1/28/1999	force	0.464	0.213	0.497	0.213	NO	OK
GRT-DND-E1844-20	FALCON-20	1/28/1999	force	0.464	0.221	0.497	0.221	NO	OK
GRT-DND-E1844-20	FALCON-20	1/29/1999	force	0.380	0.144	0.410	0.144	OK	OK
GRT-DND-E1844-20	FALCON-20	1/29/1999	force	0.380	0.193	0.410	0.193	OK	OK
GRT-DND-E1844-20	FALCON-20	1/29/1999	force	0.380	0.203	0.410	0.203	OK	OK
GRT-DND-E1844-20	FALCON-20	1/29/1999	force	0.380	0.226	0.410	0.226	OK	OK
GRT-DND-E1844-20	FALCON-20	1/29/1999	force	0.380	0.181	0.410	0.181	OK	OK

GRT-DND-E1844-20	FALCON-20	1/29/1999	force	0.380	0.25	0.410	0.250	OK	OK
GRT-DND-E1844-20	FALCON-20	1/29/1999	force	0.380	0.199	0.410	0.199	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/25/1999	force	0.883	0.457	0.839	0.457	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/28/1999	force	0.426	0.179	0.405	0.179	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/28/1999	force	0.426	0.191	0.405	0.191	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/28/1999	force	0.426	0.186	0.405	0.186	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/28/1999	force	0.426	0.216	0.405	0.216	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/28/1999	force	0.426	0.267	0.405	0.267	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/28/1999	force	0.438	0.197	0.416	0.197	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/28/1999	force	0.438	0.215	0.416	0.215	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/28/1999	force	0.438	0.266	0.416	0.266	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/28/1999	force	0.438	0.213	0.416	0.213	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/28/1999	force	0.438	0.221	0.416	0.221	NO	OK
ITTV-NASA-AC26-136	FALCON-20	1/28/1999	force	0.370	0.179	0.252	0.179	NO	OK
ITTV-NASA-AC26-136	FALCON-20	1/28/1999	force	0.370	0.191	0.258	0.191	NO	OK
ITTV-NASA-AC26-136	FALCON-20	1/28/1999	force	0.370	0.186	0.255	0.186	NO	OK
ITTV-NASA-AC26-136	FALCON-20	1/28/1999	force	0.370	0.216	0.271	0.216	NO	OK
ITTV-NASA-AC26-136	FALCON-20	1/28/1999	force	0.370	0.267	0.299	0.267	NO	OK
ITTV-NASA-AC26-136	FALCON-20	1/28/1999	force	0.270	0.197	0.261	0.197	NO	OK
ITTV-NASA-AC26-136	FALCON-20	1/28/1999	force	0.270	0.215	0.271	0.215	NO	OK
ITTV-NASA-AC26-136	FALCON-20	1/28/1999	force	0.270	0.266	0.298	0.266	NO	OK
ITTV-NASA-AC26-136	FALCON-20	1/28/1999	force	0.270	0.213	0.270	0.213	NO	OK
ITTV-NASA-AC26-136	FALCON-20	1/28/1999	force	0.270	0.221	0.274	0.221	NO	OK
SFT-TC79-E1551-100	FALCON-20	1/28/1999	force	0.352	0.179	0.137	0.179	OK	Yes
SFT-TC79-E1551-100	FALCON-20	1/28/1999	force	0.352	0.191	0.137	0.191	OK	Yes
SFT-TC79-E1551-100	FALCON-20	1/28/1999	force	0.352	0.186	0.137	0.186	OK	Yes
SFT-TC79-E1551-100	FALCON-20	1/28/1999	force	0.352	0.216	0.137	0.216	OK	Yes
SFT-TC79-E1551-100	FALCON-20	1/28/1999	force	0.352	0.267	0.137	0.267	OK	Yes
SFT-TC79-E1551-100	FALCON-20	1/28/1999	force	0.332	0.197		0.197	NO	OK
SFT-TC79-E1551-100	FALCON-20	1/28/1999	force	0.332	0.215		0.215	NO	OK
SFT-TC79-E1551-100	FALCON-20	1/28/1999	force	0.332	0.266		0.266	NO	OK
SFT-TC79-E1551-100	FALCON-20	1/28/1999	force	0.332	0.213		0.213	NO	OK
SFT-TC79-E1551-100	FALCON-20	1/28/1999	force	0.332	0.221		0.221	NO	OK
ERD-BLAZER	FALCON-20	1/18/2000	force	0.171	0.112	0.234	0.112	OK	OK
ERD-BLAZER	FALCON-20	1/18/2000	force	0.172	0.103	0.234	0.103	OK	OK
ERD-BLAZER	FALCON-20	1/18/2000	force	0.171	0.098	0.234	0.098	OK	OK
ERD-BLAZER	FALCON-20	1/18/2000	force	0.172	0.109	0.234	0.109	OK	OK
ERD-BLAZER	FALCON-20	1/18/2000	force	0.171	0.128	0.234	0.128	OK	OK
ERD-BLAZER	FALCON-20	1/18/2000	force	0.172	0.104	0.234	0.104	OK	OK
ERD-BLAZER	FALCON-20	1/18/2000	force	0.740	0.436	0.598	0.436	OK	OK
ERD-BLAZER	FALCON-20	1/19/2000	force	0.298	0.131	0.314	0.131	OK	OK
ERD-BLAZER	FALCON-20	1/19/2000	force	0.298	0.162	0.315	0.162	OK	OK
ERD-BLAZER	FALCON-20	1/19/2000	force	0.298	0.159	0.314	0.159	OK	OK
ERD-BLAZER	FALCON-20	1/19/2000	force	0.298	0.197	0.315	0.197	OK	OK
ERD-BLAZER	FALCON-20	1/19/2000	force	0.298	0.145	0.314	0.145	OK	OK
ERD-BLAZER	FALCON-20	1/20/2000	force	0.129	0.081	0.206	0.081	OK	OK
ERD-BLAZER	FALCON-20	1/20/2000	force	0.129	0.082	0.206	0.082	OK	OK
ERD-BLAZER	FALCON-20	1/20/2000	force	0.129	0.084	0.206	0.084	OK	OK
ERD-BLAZER	FALCON-20	1/20/2000	force	0.129	0.081	0.206	0.081	OK	OK
ERD-BLAZER	FALCON-20	1/20/2000	force	0.129	0.087	0.206	0.087	OK	OK
ERD-BLAZER	FALCON-20	1/20/2000	force	0.129	0.08	0.206	0.080	OK	OK
ERD-BLAZER	FALCON-20	1/20/2000	force	0.740	0.383	0.598	0.383	OK	OK
ERD-BLAZER	FALCON-20	1/20/2000	force	0.740	0.413	0.598	0.413	OK	OK
ERD-BLAZER	FALCON-20	1/21/2000	force	0.102	0.095	0.189	0.095	OK	OK
ERD-BLAZER	FALCON-20	1/21/2000	force	0.095	0.091	0.185	0.091	OK	OK
ERD-BLAZER	FALCON-20	1/21/2000	force	0.102	0.084	0.189	0.084	OK	OK
ERD-BLAZER	FALCON-20	1/21/2000	force	0.095	0.087	0.185	0.087	OK	OK
ERD-BLAZER	FALCON-20	1/21/2000	force	0.102	0.086	0.189	0.086	OK	OK
ERD-BLAZER	FALCON-20	1/21/2000	force	0.095	0.077	0.185	0.077	OK	OK

ERD-BLAZER	FALCON-20	1/21/2000	force	0.223	0.136	0.266	0.136	OK	OK
ERD-BLAZER	FALCON-20	1/21/2000	force	0.198	0.123	0.250	0.123	OK	OK
ERD-BLAZER	FALCON-20	1/21/2000	force	0.223	0.163	0.266	0.163	OK	OK
ERD-BLAZER	FALCON-20	1/21/2000	force	0.198	0.155	0.250	0.155	OK	OK
ERD-BLAZER	FALCON-20	1/21/2000	force	0.223	0.151	0.266	0.151	OK	OK
ERD-BLAZER	FALCON-20	1/21/2000	force	0.198	0.134	0.250	0.134	OK	OK
ERD-BLAZER	FALCON-20	1/24/2000	force	0.486	0.292	0.435	0.292	NO	OK
ERD-BLAZER	FALCON-20	1/24/2000	force	0.522	0.364	0.458	0.364	NO	OK
ERD-BLAZER	FALCON-20	1/24/2000	force	**0.486**	0.401	0.435	0.401	NO	OK
ERD-BLAZER	FALCON-20	1/25/2000	force	0.284	0.127	0.306	0.127	OK	OK
ERD-BLAZER	FALCON-20	1/25/2000	force	0.287	0.12	0.307	0.120	OK	OK
ERD-BLAZER	FALCON-20	1/25/2000	force	0.284	0.142	0.306	0.142	OK	OK
ERD-BLAZER	FALCON-20	1/25/2000	force	0.287	0.142	0.307	0.142	OK	OK
ERD-BLAZER	FALCON-20	1/27/2000	force	0.202	0.126	0.253	0.126	OK	OK
ERD-BLAZER	FALCON-20	1/27/2000	force	0.202	0.125	0.253	0.125	OK	OK
ERD-BLAZER	FALCON-20	1/27/2000	force	0.202	0.127	0.253	0.127	OK	OK
ERD-BLAZER	FALCON-20	1/27/2000	force	0.202	0.13	0.253	0.130	OK	OK
ERD-BLAZER	FALCON-20	1/27/2000	force	0.270	0.155	0.297	0.155	OK	OK
ERD-BLAZER	FALCON-20	1/27/2000	force	0.270	0.14	0.297	0.140	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/18/2000	force	0.350	0.112	0.350	0.112	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/18/2000	force	0.352	0.103	0.352	0.103	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/18/2000	force	0.350	0.098	0.350	0.098	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/18/2000	force	0.352	0.109	0.352	0.109	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/18/2000	force	0.350	0.128	0.350	0.128	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/18/2000	force	0.352	0.104	0.352	0.104	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/18/2000	force	0.837	0.436	0.837	0.436	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/19/2000	force	0.268	0.131	0.268	0.131	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/19/2000	force	0.279	0.162	0.279	0.162	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/19/2000	force	0.268	0.159	0.268	0.159	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/19/2000	force	0.279	0.197	0.279	0.197	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/19/2000	force	0.268	0.145	0.268	0.145	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/20/2000	force	0.238	0.081	0.238	0.081	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/20/2000	force	0.238	0.082	0.238	0.082	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/20/2000	force	0.238	0.084	0.238	0.084	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/20/2000	force	0.238	0.081	0.238	0.081	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/20/2000	force	0.238	0.087	0.238	0.087	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/20/2000	force	0.238	0.08	0.238	0.080	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/20/2000	force	0.837	0.383	0.837	0.383	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/20/2000	force	0.837	0.413	0.837	0.413	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/21/2000	force	0.309	0.095	0.309	0.095	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/21/2000	force	0.291	0.091	0.291	0.091	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/21/2000	force	0.309	0.084	0.309	0.084	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/21/2000	force	0.291	0.087	0.291	0.087	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/21/2000	force	0.309	0.086	0.309	0.086	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/21/2000	force	0.291	0.077	0.291	0.077	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/21/2000	force	0.354	0.136	0.354	0.136	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/21/2000	force	0.355	0.123	0.355	0.123	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/21/2000	force	0.354	0.163	0.354	0.163	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/21/2000	force	0.355	0.155	0.355	0.155	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/21/2000	force	0.354	0.151	0.354	0.151	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/21/2000	force	0.355	0.134	0.355	0.134	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/24/2000	force	0.590	0.292	0.590	0.292	NO	OK
IMAG-IRV-PIARC-22	FALCON-20	1/24/2000	force	0.735	0.364	0.735	0.364	NO	OK
IMAG-IRV-PIARC-22	FALCON-20	1/24/2000	force	0.590	0.401	0.590	0.401	NO	OK
IMAG-IRV-PIARC-22	FALCON-20	1/24/2000	force	0.283	0.127	0.283	0.127	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/24/2000	force	0.292	0.12	0.292	0.120	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/24/2000	force	0.283	0.142	0.283	0.142	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/24/2000	force	0.292	0.142	0.292	0.142	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/27/2000	force	0.290	0.126	0.290	0.126	OK	OK

IMAG-IRV-PIARC-22	FALCON-20	1/27/2000	force	0.290	0.125	0.290	0.125	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/27/2000	force	0.290	0.127	0.290	0.127	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/27/2000	force	0.290	0.13	0.290	0.130	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/27/2000	force	0.349	0.155	0.349	0.155	OK	OK
IMAG-IRV-PIARC-22	FALCON-20	1/27/2000	force	0.349	0.14	0.349	0.140	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/18/2000	force	0.326	0.112	0.309	0.112	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/18/2000	force	0.346	0.103	0.328	0.103	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/18/2000	force	0.326	0.098	0.309	0.098	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/18/2000	force	0.346	0.109	0.328	0.109	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/18/2000	force	0.326	0.128	0.309	0.128	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/18/2000	force	0.346	0.104	0.328	0.104	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/18/2000	force	0.867	0.436	0.823	0.436	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/19/2000	force	0.268	0.131	0.254	0.131	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/19/2000	force	0.264	0.162	0.251	0.162	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/19/2000	force	0.268	0.159	0.254	0.159	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/19/2000	force	0.264	0.197	0.251	0.197	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/19/2000	force	0.268	0.145	0.254	0.145	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/20/2000	force	0.259	0.081	0.246	0.081	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/20/2000	force	0.259	0.082	0.246	0.082	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/20/2000	force	0.259	0.084	0.246	0.084	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/20/2000	force	0.259	0.081	0.246	0.081	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/20/2000	force	0.259	0.087	0.246	0.087	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/20/2000	force	0.259	0.08	0.246	0.080	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/20/2000	force	0.867	0.383	0.823	0.383	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/20/2000	force	0.867	0.413	0.823	0.413	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/21/2000	force	0.268	0.095	0.254	0.095	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/21/2000	force	0.262	0.091	0.249	0.091	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/21/2000	force	0.268	0.084	0.254	0.084	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/21/2000	force	0.262	0.087	0.249	0.087	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/21/2000	force	0.268	0.086	0.254	0.086	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/21/2000	force	0.262	0.077	0.249	0.077	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/21/2000	force	0.360	0.136	0.342	0.136	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/21/2000	force	0.371	0.123	0.353	0.123	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/21/2000	force	0.360	0.163	0.342	0.163	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/21/2000	force	0.371	0.155	0.353	0.155	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/21/2000	force	0.360	0.151	0.342	0.151	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/21/2000	force	0.371	0.134	0.353	0.134	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/24/2000	force	0.750	0.292	0.713	0.292	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/24/2000	force	0.830	0.364	0.788	0.364	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/24/2000	force	0.750	0.401	0.713	0.401	NO	OK
IMAG-STBA-PIARC-22	FALCON-20	1/24/2000	force	0.309	0.127	0.294	0.127	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/24/2000	force	0.293	0.12	0.279	0.120	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/24/2000	force	0.309	0.142	0.294	0.142	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/24/2000	force	0.293	0.142	0.279	0.142	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/27/2000	force	0.315	0.126	0.299	0.126	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/27/2000	force	0.315	0.125	0.299	0.125	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/27/2000	force	0.315	0.127	0.299	0.127	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/27/2000	force	0.315	0.13	0.299	0.130	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/27/2000	force	0.367	0.155	0.348	0.155	OK	OK
IMAG-STBA-PIARC-22	FALCON-20	1/27/2000	force	0.367	0.14	0.348	0.140	OK	OK
				G-F&T	NC-DASH8	IRFI	NC-DASH8		
SFT-TC79-E1551-100	NC-DASH8	1/29/2001	force	0.980	0.407	0.822	0.407	OK	Yes
SFT-TC79-E1551-100	NC-DASH8	1/29/2001	force	0.980	0.429	0.822	0.429	OK	Yes
SFT-TC85-E1551-100	NC-DASH8	3/23/2001	torque	0.787	0.387		0.387	NO	OK
SFT-TC85-E1551-100	NC-DASH8	3/23/2001	torque	0.787	0.392		0.392	NO	OK
SFT-TC85-E1551-100	NC-DASH8	3/23/2001	torque	0.787	0.36		0.360	NO	OK
ERD-BLAZER	NC-DASH8	1/29/2001	force	0.670	0.407	0.633	0.407	OK	Yes
ERD-BLAZER	NC-DASH8	1/29/2001	force	0.670	0.429	0.633	0.429	OK	Yes
ERD-BLAZER	NC-DASH8	1/31/2001	force	0.266	0.174	0.315	0.174	OK	Yes

ERD-BLAZER	NC-DASH8	1/31/2001	force	0.266	0.178	0.315	0.178	OK	Yes
ERD-BLAZER	NC-DASH8	1/31/2001	force	0.266	0.17	0.315	0.170	OK	Yes
ERD-BLAZER	NC-DASH8	1/31/2001	force	0.266	0.178	0.315	0.178	OK	Yes
ERD-BLAZER	NC-DASH8	1/31/2001	force	0.266	0.179	0.315	0.179	OK	Yes
ERD-BLAZER	NC-DASH8	1/31/2001	force	0.266	0.186	0.315	0.186	OK	Yes
ERD-BLAZER	NC-DASH8	1/31/2001	force	0.266	0.174	0.315	0.174	OK	Yes
ERD-BLAZER	NC-DASH8	1/31/2001	force	0.312	0.306	0.350	0.306	NO	Yes
ERD-BLAZER	NC-DASH8	1/31/2001	force	0.312	0.188	0.350	0.188	NO	Yes
ERD-BLAZER	NC-DASH8	1/31/2001	force	0.312	0.265	0.350	0.265	NO	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.263	0.177	0.312	0.177	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.263	0.176	0.312	0.176	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.263	0.184	0.312	0.184	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.263	0.205	0.312	0.205	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.263	0.181	0.312	0.181	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.263	0.174	0.312	0.174	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.263	0.167	0.312	0.167	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.263	0.177	0.312	0.177	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.263	0.259	0.312	0.259	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.263	0.253	0.312	0.253	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.263	0.183	0.312	0.183	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.372	0.27	0.398	0.270	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.372	0.251	0.398	0.251	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.372	0.24	0.398	0.240	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.372	0.249	0.398	0.249	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.372	0.25	0.398	0.250	OK	Yes
ERD-BLAZER	NC-DASH8	2/1/2001	force	0.372	0.247	0.398	0.247	OK	Yes
ERD-23	NC-DASH8	3/21/2001	force	0.292	0.176	0.325	0.176	NO	Yes
ERD-23	NC-DASH8	3/21/2001	force	0.292	0.177	0.325	0.177	NO	Yes
ERD-23	NC-DASH8	3/21/2001	force	0.292	0.18	0.325	0.180	NO	Yes
ERD-23	NC-DASH8	3/22/2001	force	0.107	0.069	0.183	0.069	Ok	Yes
ERD-23	NC-DASH8	3/22/2001	force	0.107	0.086	0.183	0.086	Ok	Yes
ERD-23	NC-DASH8	3/22/2001	force	0.107	0.086	0.183	0.086	Ok	Yes
ERD-23	NC-DASH8	3/22/2001	force	0.107	0.089	0.183	0.089	Ok	Yes
ERD-23	NC-DASH8	3/22/2001	force	0.107	0.086	0.183	0.086	Ok	Yes
ERD-23	NC-DASH8	3/22/2001	force	0.107	0.085	0.183	0.085	Ok	Yes
ERD-23	NC-DASH8	3/22/2001	force	0.107	0.088	0.183	0.088	Ok	Yes
ERD-23	NC-DASH8	3/22/2001	force	0.107	0.087	0.183	0.087	Ok	Yes
ERD-23	NC-DASH8	3/22/2001	force	0.572	0.363	0.542	0.363	Ok	Yes
ERD-23	NC-DASH8	3/22/2001	force	0.572	0.321	0.542	0.321	NO	Yes
ERD-23	NC-DASH8	3/23/2001	force	0.728	0.387	0.663	0.387	NO	Yes
ERD-23	NC-DASH8	3/23/2001	force	0.728	0.392	0.663	0.392	NO	Yes
ERD-23	NC-DASH8	3/23/2001	force	0.728	0.36	0.663	0.360	NO	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.201	0.177	0.201	0.177	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.201	0.176	0.201	0.176	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.201	0.184	0.201	0.184	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.201	0.205	0.201	0.205	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.201	0.181	0.201	0.181	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.201	0.174	0.201	0.174	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.201	0.167	0.201	0.167	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.201	0.177	0.201	0.177	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.201	0.259	0.201	0.259	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.201	0.253	0.201	0.253	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.201	0.183	0.201	0.183	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.351	0.27	0.351	0.270	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.351	0.251	0.351	0.251	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.351	0.24	0.351	0.240	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.351	0.249	0.351	0.249	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.351	0.25	0.351	0.250	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/2/2001	force	0.351	0.247	0.351	0.247	OK	Yes

IMAG-IRV-PIARC-22	NC-DASH8	1/29/2001	force	0.870	0.407	0.870	0.407	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/29/2001	force	0.870	0.429	0.870	0.429	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/31/2001	force	0.204	0.174	0.204	0.174	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/31/2001	force	0.204	0.178	0.204	0.178	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/31/2001	force	0.204	0.17	0.204	0.170	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/31/2001	force	0.204	0.178	0.204	0.178	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/31/2001	force	0.204	0.179	0.204	0.179	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/31/2001	force	0.204	0.186	0.204	0.186	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/31/2001	force	0.204	0.174	0.204	0.174	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/31/2001	force	0.387	0.306	0.387	0.306	NO	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/31/2001	force	0.387	0.188	0.387	0.188	NO	Yes
IMAG-IRV-PIARC-22	NC-DASH8	1/31/2001	force	0.387	0.265	0.387	0.265	NO	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/21/2001	force	0.383	0.176	0.383	0.176	NO	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/21/2001	force	0.383	0.177	0.383	0.177	NO	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/21/2001	force	0.383	0.18	0.383	0.180	NO	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/22/2001	force	0.146	0.069	0.146	0.069	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/22/2001	force	0.146	0.086	0.146	0.086	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/22/2001	force	0.146	0.086	0.146	0.086	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/22/2001	force	0.146	0.089	0.146	0.089	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/22/2001	force	0.146	0.086	0.146	0.086	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/22/2001	force	0.146	0.085	0.146	0.085	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/22/2001	force	0.146	0.088	0.146	0.088	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/22/2001	force	0.146	0.087	0.146	0.087	OK	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/22/2001	force	0.655	0.363	0.655	0.363	NO	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/22/2001	force	0.655	0.321	0.655	0.321	NO	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/23/2001	force	0.730	0.387	0.730	0.387	NO	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/23/2001	force	0.730	0.392	0.730	0.392	NO	Yes
IMAG-IRV-PIARC-22	NC-DASH8	3/23/2001	force	0.730	0.36	0.730	0.360	NO	Yes
SFT-99-E1551-100	NC-DASH8	3/21/2001	torque	0.164	0.176	0.218	0.176	NO	Yes
SFT-99-E1551-100	NC-DASH8	3/21/2001	torque	0.164	0.177	0.218	0.177	NO	Yes
SFT-99-E1551-100	NC-DASH8	3/21/2001	torque	0.164	0.18	0.218	0.180	NO	Yes
SFT-99-E1551-100	NC-DASH8	3/22/2001	torque	0.144	0.069		0.069	OK	Yes
SFT-99-E1551-100	NC-DASH8	3/22/2001	torque	0.144	0.086		0.086	OK	Yes
SFT-99-E1551-100	NC-DASH8	3/22/2001	torque	0.144	0.086		0.086	OK	Yes
SFT-99-E1551-100	NC-DASH8	3/22/2001	torque	0.144	0.089		0.089	OK	Yes
SFT-99-E1551-100	NC-DASH8	3/22/2001	torque	0.144	0.086		0.086	OK	Yes
SFT-99-E1551-100	NC-DASH8	3/22/2001	torque	0.144	0.085		0.085	OK	Yes
SFT-99-E1551-100	NC-DASH8	3/22/2001	torque	0.144	0.088		0.088	OK	Yes
SFT-99-E1551-100	NC-DASH8	3/22/2001	torque	0.144	0.087		0.087	OK	Yes
SFT-99-E1551-100	NC-DASH8	3/22/2001	torque	0.810	0.363		0.363	NO	Yes
SFT-99-E1551-100	NC-DASH8	3/22/2001	torque	0.810	0.321		0.321	NO	Yes
SFT-99-E1551-100	NC-DASH8	3/23/2001	torque	0.866	0.387		0.387	NO	Yes
SFT-99-E1551-100	NC-DASH8	3/23/2001	torque	0.866	0.392		0.392	NO	Yes
SFT-99-E1551-100	NC-DASH8	3/23/2001	torque	0.866	0.36		0.360	NO	Yes
				G-F&T	DU328	IRFI	DU328		
ERD-BLAZER	DU328	2/28/2001		**0.820**	0.447	0.751	0.447	OK	Yes
ERD-BLAZER	DU328	2/28/2001		**0.820**	0.422	0.751	0.422	OK	Yes
ERD-BLAZER	DU328	2/28/2001		**0.820**	0.382	0.751	0.382	NO	Yes
ERD-BLAZER	DU328	2/28/2001		**0.820**	0.377	0.751	0.377	NO	Yes
ERD-BLAZER	DU328	3/1/2001		0.116	0.041	0.196	0.041	OK	Yes
ERD-BLAZER	DU328	3/1/2001		0.116	0.051	0.196	0.051	OK	Yes
ERD-BLAZER	DU328	3/1/2001		0.116	0.052	0.196	0.052	OK	Yes
ERD-BLAZER	DU328	3/1/2001		0.116	0.064	0.196	0.064	OK	Yes
ERD-BLAZER	DU328	3/1/2001		0.116	0.098	0.196	0.098	OK	Yes
ERD-BLAZER	DU328	3/1/2001		**0.285**	0.36	0.329	0.360	NO	Yes
ERD-BLAZER	DU328	3/1/2001		**0.285**	0.358	0.329	0.358	NO	Yes
ERD-BLAZER	DU328	3/1/2001		**0.285**	0.398	0.329	0.398	NO	Yes
SFT-TC79-E1551-100	DU328	2/28/2001		0.927	0.447	0.780	0.447	OK	Yes
SFT-TC79-E1551-100	DU328	2/28/2001		0.927	0.422	0.780	0.422	OK	Yes

SFT-TC79-E1551-100	DU328	2/28/2001		0.927	0.382	0.780	0.382	NO	Yes
SFT-TC79-E1551-100	DU328	2/28/2001		0.927	0.377	0.780	0.377	NO	Yes
SFT-TC79-E1551-100	DU328	3/1/2001		0.118	0.041	0.143	0.041	OK	Yes
SFT-TC79-E1551-100	DU328	3/1/2001		0.118	0.051	0.143	0.051	OK	Yes
SFT-TC79-E1551-100	DU328	3/1/2001		0.118	0.052	0.143	0.052	OK	Yes
SFT-TC79-E1551-100	DU328	3/1/2001		0.118	0.064	0.143	0.064	OK	Yes
SFT-TC79-E1551-100	DU328	3/1/2001		0.118	0.098	0.143	0.098	OK	Yes
SFT-TC79-E1551-100	DU328	3/1/2001		0.328	0.36	0.308	0.360	NO	Yes
SFT-TC79-E1551-100	DU328	3/1/2001		0.328	0.358	0.308	0.358	NO	Yes
SFT-TC79-E1551-100	DU328	3/1/2001		0.328	0.398	0.308	0.398	NO	Yes
ASFT-801-E1551-30	DU328	2/28/2001		0.856	0.447	0.802	0.447	OK	Yes
ASFT-801-E1551-30	DU328	2/28/2001		0.856	0.422	0.802	0.422	OK	Yes
ASFT-801-E1551-30	DU328	2/28/2001		0.856	0.382	0.802	0.382	NO	Yes
SAR-527-AERO-100	DU328	3/1/2001		0.274	0.36	0.232	0.360	NO	Yes
SAR-527-AERO-100	DU328	3/1/2001		0.274	0.358	0.232	0.358	NO	Yes
SAR-527-AERO-100	DU328	3/1/2001		0.274	0.398	0.232	0.398	NO	Yes
ASFT-801-UNIT-100	DU328	3/1/2001		0.325	0.398	0.335	0.398	NO	Yes
BV11-VIE-T520-100	DU328	2/28/2001		0.880	0.447	0.772	0.447	OK	Yes
BV11-VIE-T520-100	DU328	2/28/2001		0.880	0.422	0.772	0.422	OK	Yes
BV11-VIE-T520-100	DU328	2/28/2001		0.880	0.382	0.772	0.382	NO	Yes
BV11-VIE-T520-100	DU328	2/28/2001		0.880	0.377	0.772	0.377	NO	Yes
BV11-VIE-T520-100	DU328	3/1/2001		0.092	0.041	0.124	0.041	OK	Yes
BV11-VIE-T520-100	DU328	3/1/2001		0.092	0.051	0.124	0.051	OK	Yes
BV11-VIE-T520-100	DU328	3/1/2001		0.092	0.052	0.124	0.052	OK	Yes
BV11-VIE-T520-100	DU328	3/1/2001		0.092	0.064	0.124	0.064	OK	Yes
BV11-VIE-T520-100	DU328	3/1/2001		0.092	0.098	0.124	0.098	OK	Yes
BV11-VIE-T520-100	DU328	3/1/2001		0.289	0.36	0.286	0.360	OK	Yes
BV11-VIE-T520-100	DU328	3/1/2001		0.289	0.358	0.286	0.358	NO	Yes
BV11-VIE-T520-100	DU328	3/1/2001		0.289	0.398	0.286	0.398	NO	Yes
BV11-ZUR-T49-20	DU328	2/28/2001		0.928	0.447	0.713	0.447	OK	Yes
BV11-ZUR-T49-20	DU328	2/28/2001		0.928	0.422	0.713	0.422	OK	Yes
BV11-ZUR-T49-20	DU328	2/28/2001		0.928	0.382	0.713	0.382	NO	Yes
BV11-ZUR-T49-20	DU328	2/28/2001		0.928	0.377	0.713	0.377	NO	Yes
BV11-ZUR-T49-20	DU328	3/1/2001		0.107	0.041	0.109	0.041	OK	Yes
BV11-ZUR-T49-20	DU328	3/1/2001		0.107	0.051	0.109	0.051	OK	Yes
BV11-ZUR-T49-20	DU328	3/1/2001		0.107	0.052	0.109	0.052	OK	Yes
BV11-ZUR-T49-20	DU328	3/1/2001		0.107	0.064	0.109	0.064	OK	Yes
BV11-ZUR-T49-20	DU328	3/1/2001		0.107	0.098	0.109	0.098	OK	Yes
BV11-ZUR-T49-20	DU328	3/1/2001		0.343	0.36	0.283	0.360	OK	Yes
BV11-ZUR-T49-20	DU328	3/1/2001		0.343	0.358	0.283	0.358	NO	Yes
BV11-ZUR-T49-20	DU328	3/1/2001		0.343	0.398	0.283	0.398	NO	Yes
IMAG-STBA-PIARC-22	DU328	2/28/2001		0.793	0.447	0.754	0.447	OK	Yes
IMAG-STBA-PIARC-22	DU328	2/28/2001		0.793	0.422	0.754	0.422	OK	Yes
IMAG-STBA-PIARC-22	DU328	2/28/2001		0.793	0.382	0.754	0.382	NO	Yes
IMAG-STBA-PIARC-22	DU328	2/28/2001		0.793	0.377	0.754	0.377	NO	Yes
IMAG-STBA-PIARC-22	DU328	3/1/2001		0.159	0.041	0.151	0.041	OK	Yes
IMAG-STBA-PIARC-22	DU328	3/1/2001		0.159	0.051	0.151	0.051	OK	Yes
IMAG-STBA-PIARC-22	DU328	3/1/2001		0.159	0.052	0.151	0.052	OK	Yes
IMAG-STBA-PIARC-22	DU328	3/1/2001		0.159	0.064	0.151	0.064	OK	Yes
IMAG-STBA-PIARC-22	DU328	3/1/2001		0.159	0.098	0.151	0.098	OK	Yes
IMAG-STBA-PIARC-22	DU328	3/1/2001		0.297	0.36	0.282	0.360	NO	Yes
IMAG-STBA-PIARC-22	DU328	3/1/2001		0.297	0.358	0.282	0.358	NO	Yes
IMAG-STBA-PIARC-22	DU328	3/1/2001		0.297	0.398	0.282	0.398	NO	Yes
SAR-527-E1551-30	DU328	2/28/2001		0.920	0.447	0.841	0.447	OK	Yes
SAR-527-E1551-30	DU328	2/28/2001		0.920	0.422	0.841	0.422	OK	Yes
SAR-527-E1551-30	DU328	2/28/2001		0.920	0.382	0.841	0.382	NO	Yes
SAR-527-E1551-30	DU328	2/28/2001		0.920	0.377	0.841	0.377	NO	Yes
SAR-527-E1551-30	DU328	3/1/2001		0.093	0.041	0.160	0.041	OK	Yes
SAR-527-E1551-30	DU328	3/1/2001		0.093	0.051	0.160	0.051	OK	Yes

SAR-527-E1551-30	DU328	3/1/2001		0.093	0.052	0.160	0.052	OK	Yes
SAR-527-E1551-30	DU328	3/1/2001		0.093	0.064	0.160	0.064	OK	Yes
SAR-527-E1551-30	DU328	3/1/2001		0.093	0.098	0.160	0.098	OK	Yes
SAR-813-E1551-30	DU328	2/28/2001		0.882	0.447	0.798	0.447	OK	Yes
SAR-813-E1551-30	DU328	2/28/2001		0.882	0.422	0.798	0.422	OK	Yes
SAR-813-E1551-30	DU328	2/28/2001		0.882	0.382	0.798	0.382	NO	Yes
SAR-813-E1551-30	DU328	2/28/2001		0.882	0.377	0.798	0.377	NO	Yes
SAR-813-E1551-30	DU328	3/1/2001		0.092	0.041	0.147	0.041	OK	Yes
SAR-813-E1551-30	DU328	3/1/2001		0.092	0.051	0.147	0.051	OK	Yes
SAR-813-E1551-30	DU328	3/1/2001		0.092	0.052	0.147	0.052	OK	Yes
SAR-813-E1551-30	DU328	3/1/2001		0.092	0.064	0.147	0.064	OK	Yes
SAR-813-E1551-30	DU328	3/1/2001		0.092	0.098	0.147	0.098	OK	Yes
SAR-814-TRBL-30	DU328	2/28/2001		0.943	0.447	0.746	0.447	OK	Yes
SAR-814-TRBL-30	DU328	2/28/2001		0.943	0.422	0.746	0.422	OK	Yes
SAR-814-TRBL-30	DU328	2/28/2001		0.943	0.382	0.746	0.382	NO	Yes
SAR-814-TRBL-30	DU328	2/28/2001		0.943	0.377	0.746	0.377	NO	Yes
SAR-814-TRBL-30	DU328	3/1/2001		0.077	0.041	0.123	0.041	OK	Yes
SAR-814-TRBL-30	DU328	3/1/2001		0.077	0.051	0.123	0.051	OK	Yes
SAR-814-TRBL-30	DU328	3/1/2001		0.077	0.052	0.123	0.052	OK	Yes
SAR-814-TRBL-30	DU328	3/1/2001		0.077	0.064	0.123	0.064	OK	Yes
SAR-814-TRBL-30	DU328	3/1/2001		0.077	0.098	0.123	0.098	OK	Yes
SAR-814-TRBL-30	DU328	3/1/2001		0.276	0.36	0.267	0.360	NO	Yes
SAR-814-TRBL-30	DU328	3/1/2001		0.276	0.358	0.267	0.358	NO	Yes
SAR-814-TRBL-30	DU328	3/1/2001		0.276	0.398	0.267	0.398	NO	Yes
ASFT-801-E1551-30	DU328	2/28/2001		0.856	0.377	0.802	0.377	NO	Yes
ASFT-801-UNIT-100	DU328	3/1/2001		0.103	0.041	0.140	0.041	OK	Yes
ASFT-801-UNIT-100	DU328	3/1/2001		0.103	0.051	0.140	0.051	OK	Yes
ASFT-801-UNIT-100	DU328	3/1/2001		0.103	0.052	0.140	0.052	OK	Yes
ASFT-801-UNIT-100	DU328	3/1/2001		0.103	0.064	0.140	0.064	OK	Yes
ASFT-801-UNIT-100	DU328	3/1/2001		0.103	0.098	0.140	0.098	OK	Yes
ASFT-801-UNIT-100	DU328	3/1/2001		0.325	0.36	0.335	0.360	OK	Yes
ASFT-801-UNIT-100	DU328	3/1/2001		0.325	0.358	0.335	0.358	NO	Yes