BOMBARDIER

de Havilland
Material Specification

TITLE:	**FOAM RIGID, FIRE RETARDANT**
SPECIFICATION NUMBER:	**DHMS P 1.29**
ISSUE:	**D**
AMENDMENT:	**--**
DATE:	**October 18, 2009**
PAGE:	**1 of 19**

Prepared by: Approved by:

SIGNED ORIGINAL ON FILE

Hai-Yen Tran
Materials Technology

Leonard K. John
Materials Technology

REVISION RECORD

Issue	Page	Description and Reason for Change
Original Amd. 1	19	Product RF500 from Fabricators, Inc. was added to the QPL
Original Amd. 2	2 3 5	Add a note at the end of Para. 1.2 Class B now changed to Class A Delete all reference to "extinguishing time"
A		This is a revised specification, detailed changes will not be noted.
A Amd. 1	19	New product from General Plastics was added.
A Amd. 2	19	Grades were added to the product list.
B		This is a revised specification, detailed changes will not be noted.
B Amd. 1	19	Products FR10005, FR10010, FR10015, FR10020 were deleted from QPL. Products FR3705, FR3710, FR3715, FR3720 were added to the QPL.
B Amd. 2	3	Flammability Requirements was added to section 2.2 and 3.7.
B Amd. 3	19	Delete products FR3705, FR3710, FR3715 and FR3720 from QPL. Add products FR-6705, FR-6710, FR-6715 and FR-6720 to the QPL.
C		This is a complete revised issue. Detail changes have not been noted.

REVISION RECORD

Issue	Page	Description and Reason for Change
D		This is a complete revised issue. Detail changes have not been noted. Clarified Flammability test specimen dimensions , 12 sec vertical testing Add Compressive Strength requirements to table 2 (extrapolate from Figures 4-7)

1 SCOPE

This specification covers the requirements for a rigid, fire retardant, closed cell urethane foam suitable for applications in composite constructions.

1.1 Classification

The foam shall be supplied in one of the following grades and forms as applicable.

Form A-2 Slab stock with a thickness tolerance of ± 0.005" and with the foam rise direction parallel to the thickness dimension.

Grades 1 - 4: Polyurethane Foam, Polyether Base

Grade 1 5 lb/cu.ft.

Grade 2 10 lb/cu.ft.

Grade 3 15 lb/cu.ft.

Grade 4 20 lb/cu.ft.

2 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. In the event of conflicting requirements between this and the specifications listed below, the requirements of this specification shall take precedence. Where a specific issue is not stated, the current issue shall be used.

2.1 American Society for Testing and Materials

ASTM C272	-	Water Absorption of Core Materials for Structural Sandwich Constructions
ASTM C273	-	Method of Shear Test in Flatwise Plane of Flat Sandwich Construction or Sandwich Cores.
ASTM D1621	-	Compressive Strength of Rigid Cellular Plastics
ASTM D1622	-	Apparent density of Rigid Cellular Plastics

2.2 Federal Aviation Administration

FAR 25.853(a), APP. F, PART I (a)(1)(ii)- Flammability Requirements

Amd. 25-86

3 REQUIREMENTS

3.1 General

All surfaces of slab material shall have a cut finish unless otherwise specified.

All products shall be uniform in quality and condition, clean and free from foreign materials and imperfections which are detrimental to fabrication, appearance, or function of the parts.

3.2 Colour

The material shall be furnished in its natural colour, unless otherwise specified.

3.3 Toxicity

The cured foam shall not cause any harmful effects when in prolonged contact with the skin.

3.4 Flammability

0.5 inch thick specimen of the cured foam shall be tested and shall meet the requirements of FAR 25.853(a), APP. F, PART I (a)(1)(ii) Amd. 25-86 (12 sec vertical).

3.5 Visible Defects

The foams covered by this specification shall be free from the visible defects listed in **Table 1**.

3.6 Physical Properties

Grade 1-4 foam shall meet the requirements specified in **Table 2**.

3.7 Odour

The character or intensity of the odour shall not be objectionable or offensive to the user.

Table 1: Visible Defects

Defects	Permissible Limits
Splits or Cracks	None tolerated
Large Voids (see Note) - larger than 1/4 inch diameter - 1 inch depth or deeper	 None tolerated None tolerated (Slabs more than 1/4 inch thick shall not have elongated voids all the way through the slab. Slabs 1/4 inch thick or less not have more than 4 such holes 1/16 to 1/8 inch in diameter, or more than 7 such holes 1/32 to 1/16 inch in diameter per square foot surface area).
Bubbles 1/8 - 1/4 inch diameter 1/16 - 1/8 inch diameter	 No more than 5 per ft^2 shall be tolerated No more than 30 per ft^2 shall be tolerated
None-uniform areas (Variation in colour from batch to batch or a streaked condition in the slabs is not objectionable)	Concentrated areas of poor construction, irregular cells, hard and soft spots, etc., covering more than 10 percent of the total visible area shall be cause for rejection of the material.

NOTE: The diameter measurement is Considered parallel to the flat surface of the slab and the depth measurement perpendicular.

Table 2: Physical Property Requirements Grade 1-4 Foam

Property	Test Method/ Section	Unit	Requirement
Density	ASTM D1622	lb./cu.ft.	Per grade specification ± 10%
Fastener Retention	Para.4.2	lb.	140 minimum
Water Absorption by Weight - 24 hrs immersion	ASTM C272	%	Figure 8
Shear Strength	Para.4.3	psi	Figure 2
Shear Modulus	Para.4.3	psi	Figure 3
Compressive Strength at 75±5°F Grade 1 (5 pcf) Grade 2 (10 pcf) Grade 3 (15 pcf) Grade 4 (20 pcf)	ASTM D1621 Procedure A	psi	 100 300 565 870
Compressive Modulus at 75±5°F Grade 1 (5 pcf) Grade 2 (10 pcf) Grade 3 (15 pcf) Grade 4 (20 pcf)	ASTM D1621 Procedure A	psi	 2800 8600 16,300 25,600
Compressive Strength at 250 ± 10°F	ASTM D1621 Procedure A	psi	Figure 6
Compressive Modulus at 250 ± 10°F	ASTM D1621 Procedure A	psi	Figure 7
Dimensional Stability	Para.4.5	in.	± 2%
Flammability	Para.3.4	_	FAR 25.853(a), APP. F, PART I (a)(1)(ii) Amd. 25-86

4 TEST PROCEDURES

4.1 General

Unless otherwise specified, specimens shall be prepared and tested at 75 ± 5°F and a relative humidity of 50 ± 10%. Unless otherwise specified, five test specimens shall be used per test.

4.2 Fastener Retention

This test shall be performed on Grade 4 foam only. Five test specimens, 1" x 2" x 1", shall be prepared by drilling a 1/32" diameter, 7/8" depth pilot hole. Each test specimen shall be mounted in the test fixture shown in **Figure 1** using a 7/8" No.6 wood screw. The load required to completely remove the screw from the foam shall be determined using a pulling rate of 0.05"/Min.

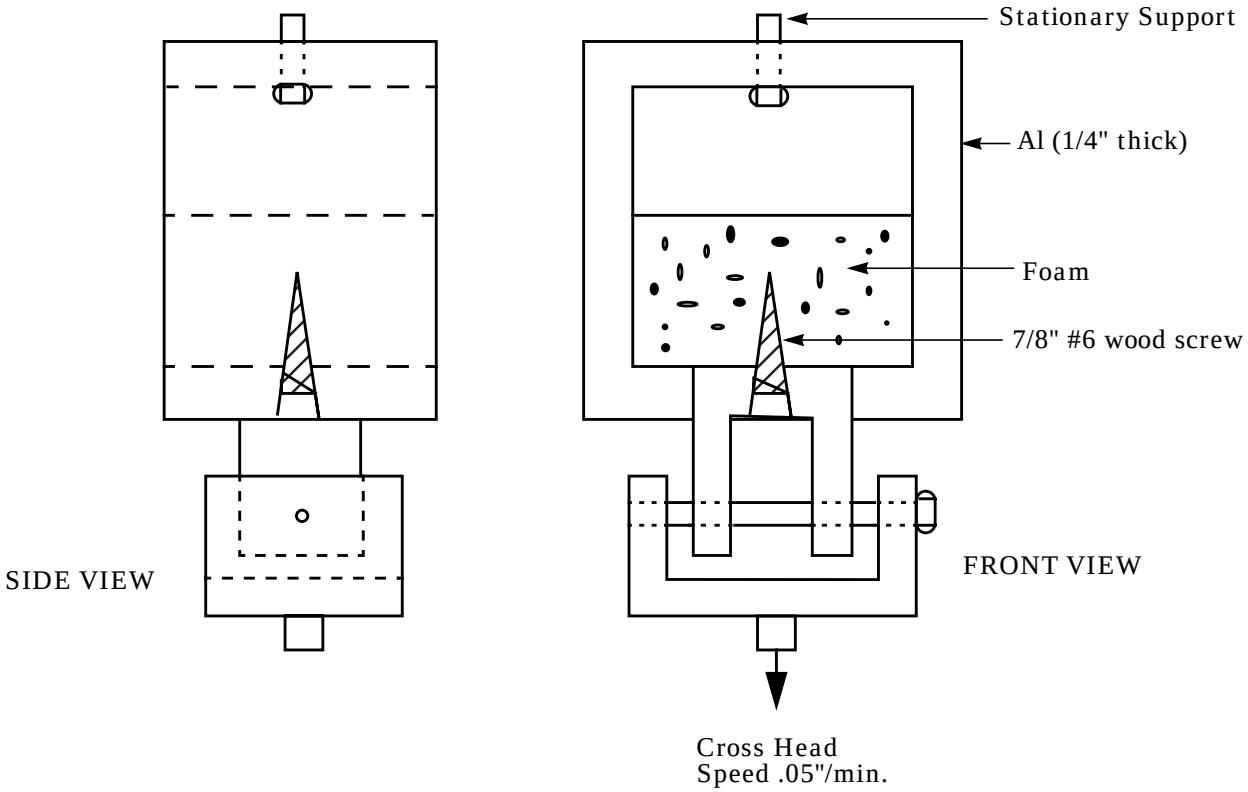

FIGURE 1. Fastener Retention Test Apparatus

4.3 Shear Strength and Modulus

Test specimens shall be prepared and tested per ASTM C273. The test specimens shall be bonded directly to the shear plates using a suitable epoxy adhesive (3M EC2216 B/A Grey or Hysol EA934NA).

4.4 Compressive Strength

Five specimens each 2 inches x 2 inches x 1 inch thick shall be prepared and tested per ASTM 1621.

4.5 Dimensional Stability

4.5.1 A 3" x 12" specimen 0.50 inches thick shall be cut from each bun.

4.5.2 The specimen shall be conditioned for 24 hours $70^{o} \pm 5^{o}$F and 50 ± 5% relative humidity. The specimen thickness shall then be measured within ± 0.001 inch. A minimum of five measurements, spaced two inches apart shall be taken and averaged.

4.5.3 The specimen shall be placed on a 1/4" thick aluminum plate and a minimum vacuum pressure of 20" of mercury shall be applied by the use of a bag or diaphragm. The specimen shall then be placed in an air circulating oven for two hours at 250 ± 10^{o}F. Vacuum pressure must be maintained until the part has cooled to 120^{o}F or less.

4.5.4 The specimen shall be reconditioned and the thickness remeasured .

4.5.5 Calculate percent dimensional change as follows:

$$\% \text{ Dimensional Change} = \frac{A - B}{A} \times 100$$

A = Original thickness (average)

B = Thickness after heating (average)

4.6 Water Absorption by Weight

4.6.1 Test in accordance with ASTM C272 using three specimens each 2 inches x 2 inches x 1 inch.

4.7 Flammability

4.7.1 Three 3" X 12" specimens, 0.50 inches thick shall be cut from each bun. The specimens shall be tested and shall meet the requirements of FAR 25.853(a), APP. F, PART I (a)(1)(ii) Amd. 25-86 (12 sec vertical).

5 QUALITY ASSURANCE

5.1 Qualification

5.1.1 A supplier is responsible for the performance of all qualification testing, as specified in **Table 3** of this specification. A three lots/batches qualification is required.

5.1.2 A supplier desiring qualification shall submit one copy of a report showing actual qualification test data and a sufficient quantity of product for de Havilland evaluation tests.

5.1.3 Upon review of supplier's data and de Havilland tests, the supplier will be advised either of product qualification or reasons for failure.

5.1.4 Products that are qualified will be listed in the Qualified Products List of this specification.

5.1.5 No changes in the method of manufacture and/or formulation shall be made without notification and prior written approval of Materials Technology and Quality Assurance Departments .

5.1.6 Requalification of the product may be requested by the purchaser for any changes in the method of manufacture and/or formulation.

5.2 Qualification by Similarity

Where a product has been qualified to another similar specification, the supplier may submit the qualification data applicable to this specification for consideration. The similar specification may be a government, company, or other specification where the requirements are similar to this specification.

5.3 Acceptance Tests

5.3.1 Unless otherwise specified in the contract or purchase order, the supplier is responsible for all acceptance tests, as specified in **Table 3** of this specification.

5.3.2 The supplier, performing acceptance tests per **Para.5.3.1**, shall furnish with each lot of product one copy of an acceptance Test Report showing actual test data conformance to the acceptance tests specified in **Table 3**. The report shall include the supplier's batch identification.

5.3.3 de Havilland reserves the right to perform any or all of the tests set forth in this specification to ensure that the product continues to meet specification requirements. Any product not meeting the requirements of this specification will be returned to the supplier at the supplier's expense.

Table 3: Qualification and Batch Acceptance Tests

Property	Paragraph	Qualification	Acceptance
Finish	Para.3.1	x	x
Colour	Para.3.2	x	
Toxicity	Para.3.3	x	
Density	Table 2	x	x
Fastener Retention	Table 2	x	
Water Absorption by weight	Table 2	x	
Shear Strength	Table 2	x	
Shear Modulus	Table 2	x	
Compressive Strength at 75 ± 5°F	Table 2	x	x
Compressive Modulus at 75 ± 5°F	Table 2	x	
Compressive Strength at 250 ± 10°F	Table 2	x	
Compressive Modulus at 250 ±10°F	Table 2	x	
Flammability	Table 2	x	x

5.4 Definitions

Lot is defined as the end product of all the raw materials mixed and/or manufactured at the same time and place.

Lot Number - Identification for each shipment of material

6 ORDERING DATA

6.1 Prerequisite

Material Furnished under this specification for production use shall be qualified and listed on the Qualified Products List prior to issuing of a Purchase Order.

6.2 Procurement Documents

Procurement documents shall specify the following:

- Title, Number, Issue and Amendment Number of this Specification.
- Grade and Form (as applicable).
- Length, Width and Thickness.

7 PREPARATION FOR DELIYERY

7.1 Identification

The foam slabs shall be identified with permanent ink marking by stencil or rubber stamp with a suitable (non-degrading) ink. The color of the ink shall contrast with the foam surface.

Each slab shall be legibly marked with the following:

- DHMS P1.29 Grade, Form (as applicable)
- Manufacturer's Name and Compound Number
- Batch Number
- Date of Manufacture

7.2 Packaging and Marking

Packaging shall be of such a nature as to prevent damage during shipment or storage.

Each container shall be permanently and legibly marked with the following information:

- DHMS P1.29 Grade, Form (as applicable)
- de Havilland Purchase Order Number
- Date of Manufacture
- Manufacturer's Name
- Quantity
- Lot Number

8 HEALTH AND SAFETY DATA

When supplying samples for qualification per **Para.5.1.2**, the supplier shall submit a Material Safety Data Sheet (MSDS) complying with the "Controlled Products Regulations" of the Hazardous Products Act (also known as W.H.M.I.S. Regulations). The document must state all hazardous ingredients, safe-handling procedures, first-aid measures, fire and explosion data, re-activity data, physical properties, preparation information and procedures for storage and disposal.

This (MSDS) must then be supplied with a completed DH 4339 "Application To Introduce A New Material" form to the Material Safety Committee.

Upon receipt of DH 4340 "Recommendation" form that approves the use of the material, it can then be included on the Qualified Products List.

NOTE: Any changes in the formulation of the material require a re-submission of the Material Safety Data Sheet.

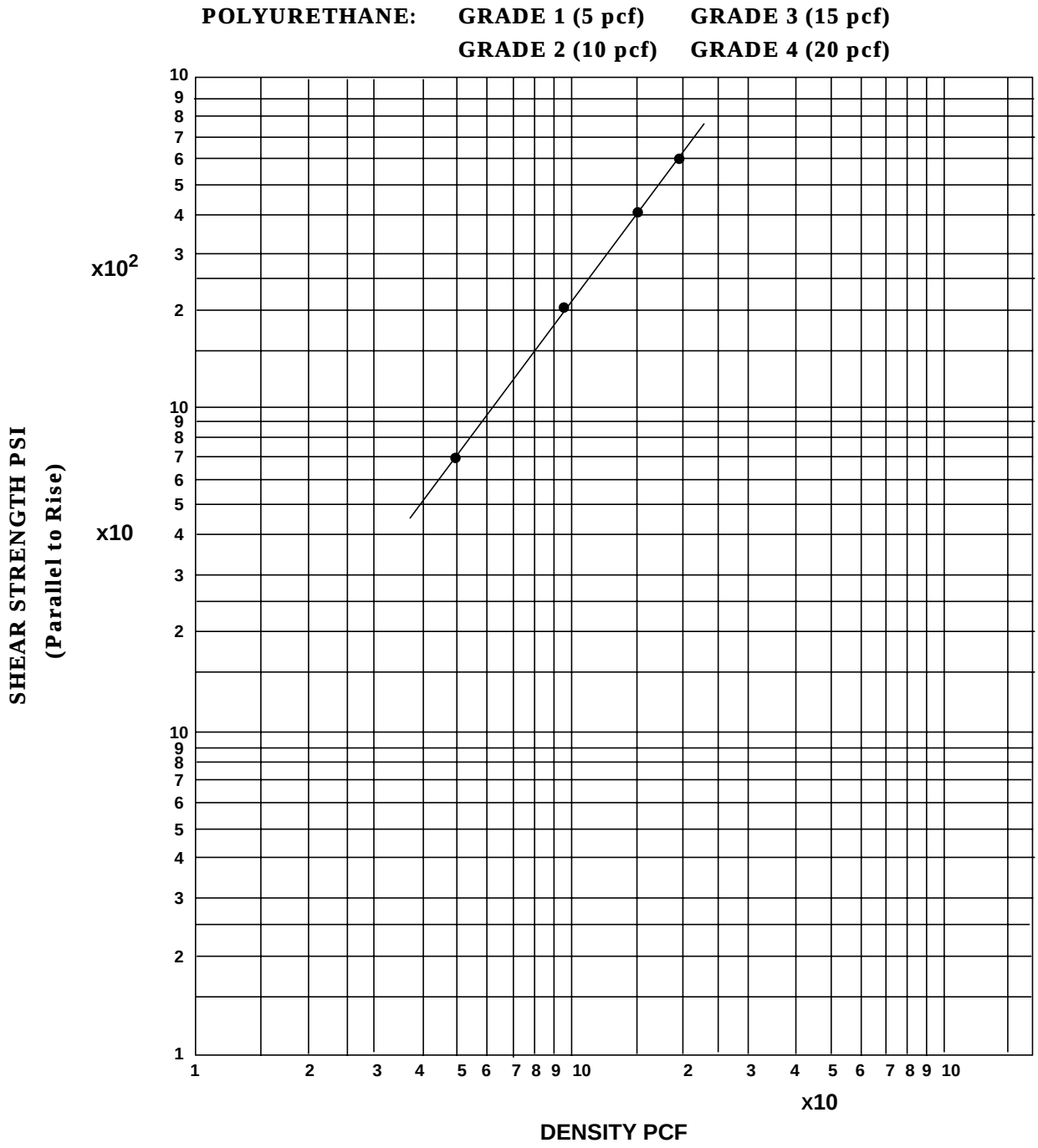

FIGURE 2. MINIMUM SHEAR STRENGTH REQUIREMENTS AT 75°F ± 5°F

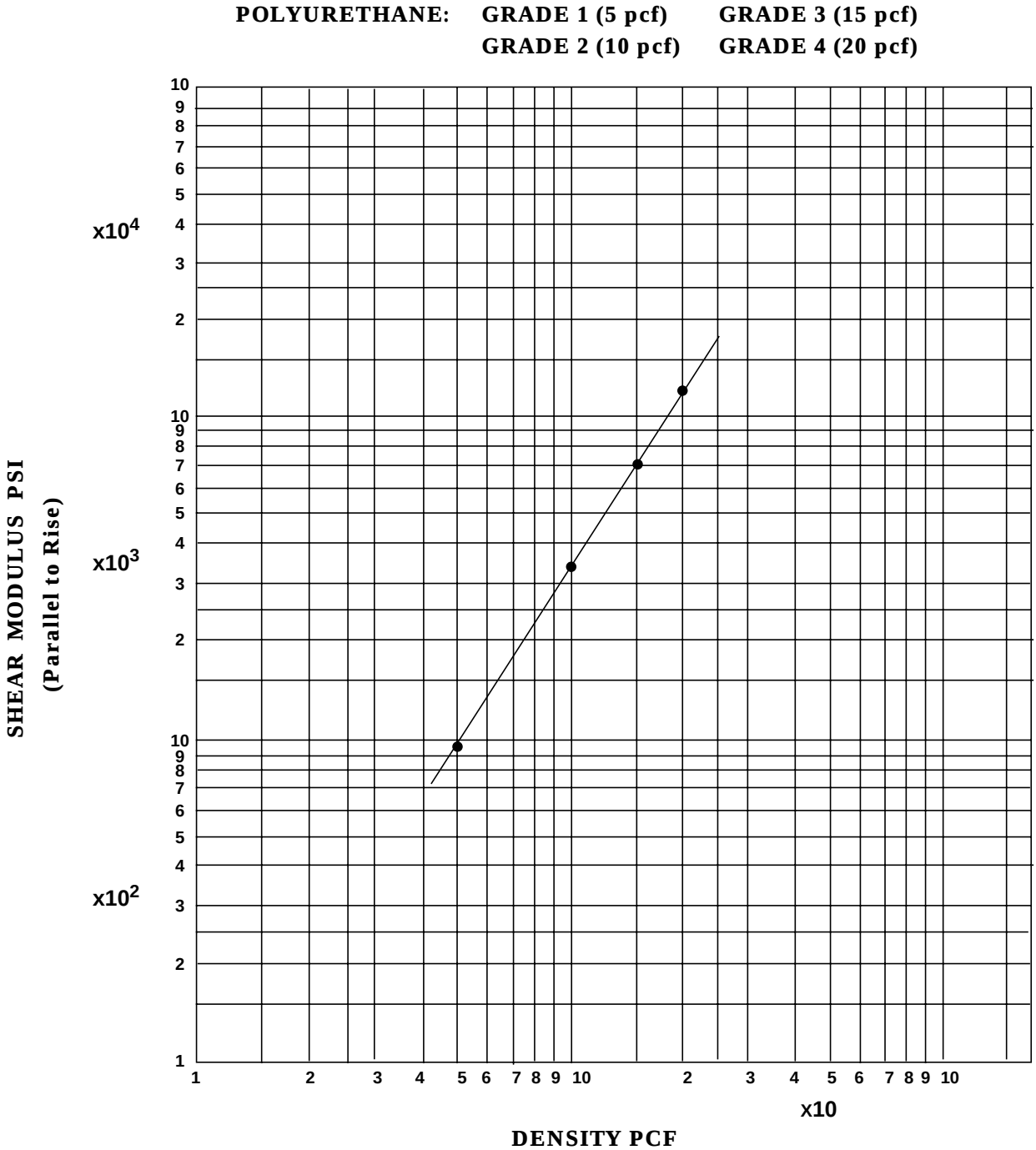

FIGURE 3. MINIMUM SHEAR MODULUS REQUIREMENTS AT 75^{O}F ± 5^{O}F

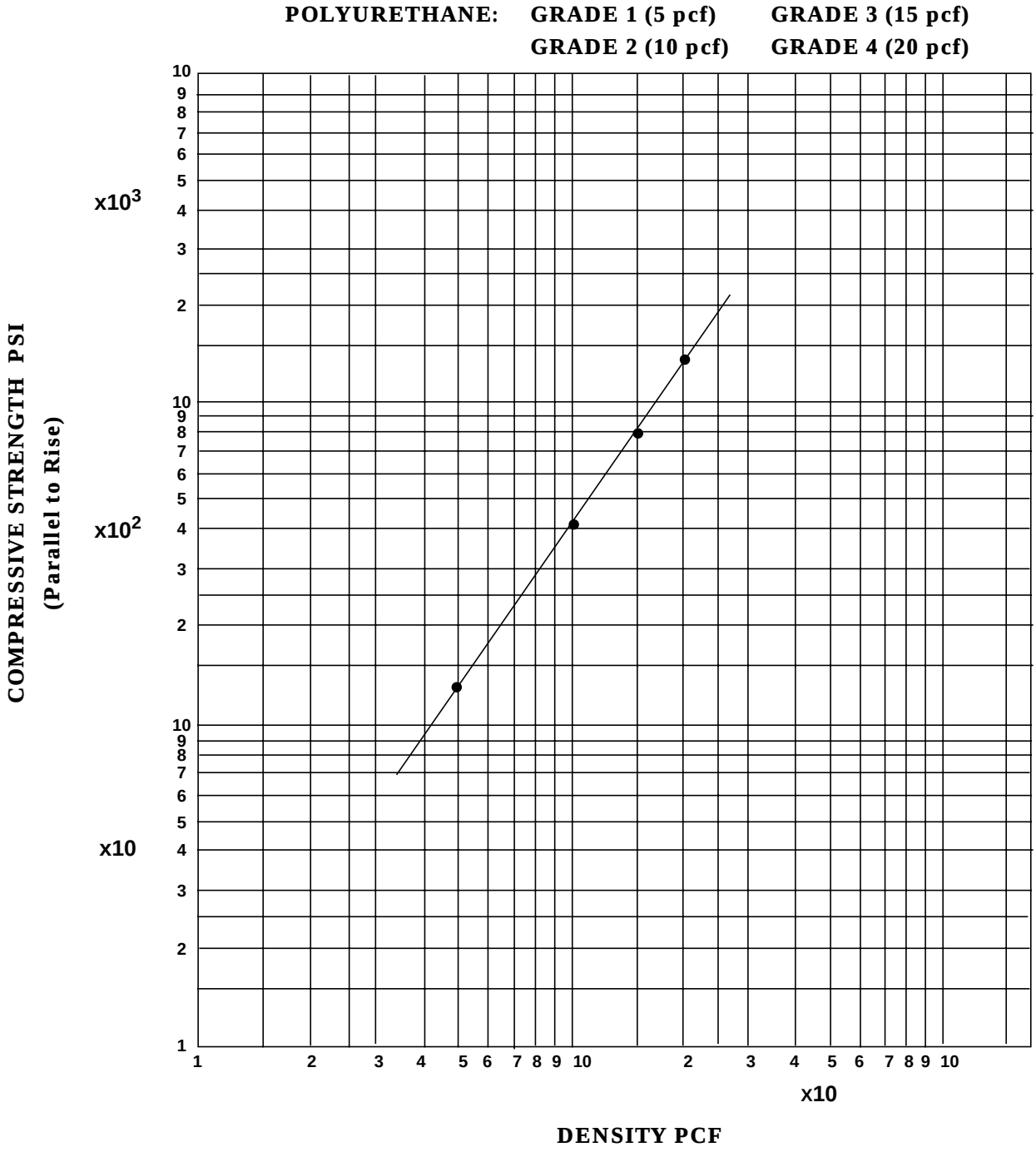

FIGURE 4. MINIMUM COMPRESSIVE STRENGTH REQUIREMENTS AT 75°F ± 5°F

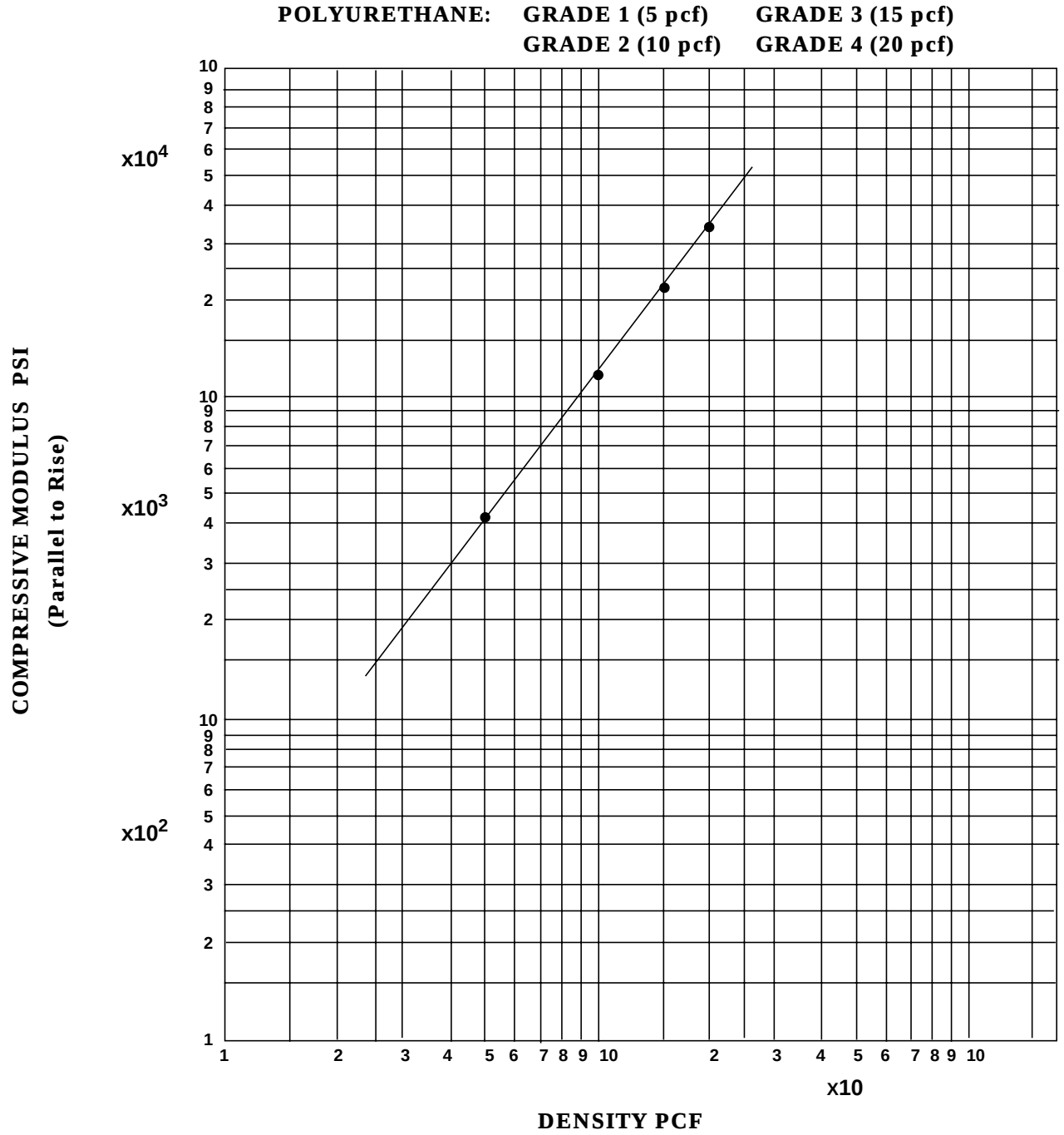

FIGURE 5. MINIMUM COMPRESSIVE MODULUS REQUIREMENTS AT 75^{O}F ± 5^{O}F

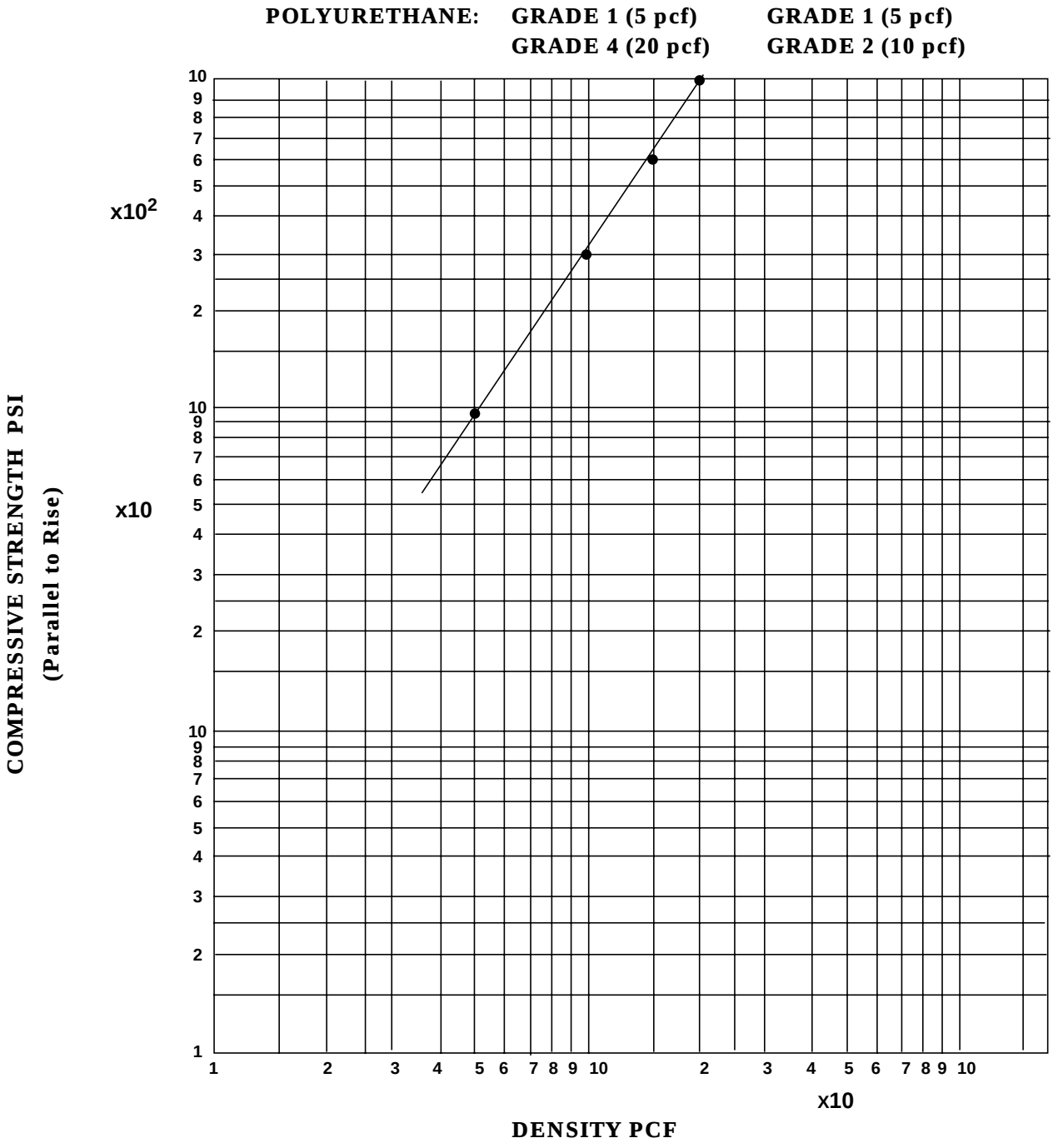

FIGURE 6. MINIMUM COMPRESSIVE STRENGTH REQUIREMENTS AT 250° F ± 10° F

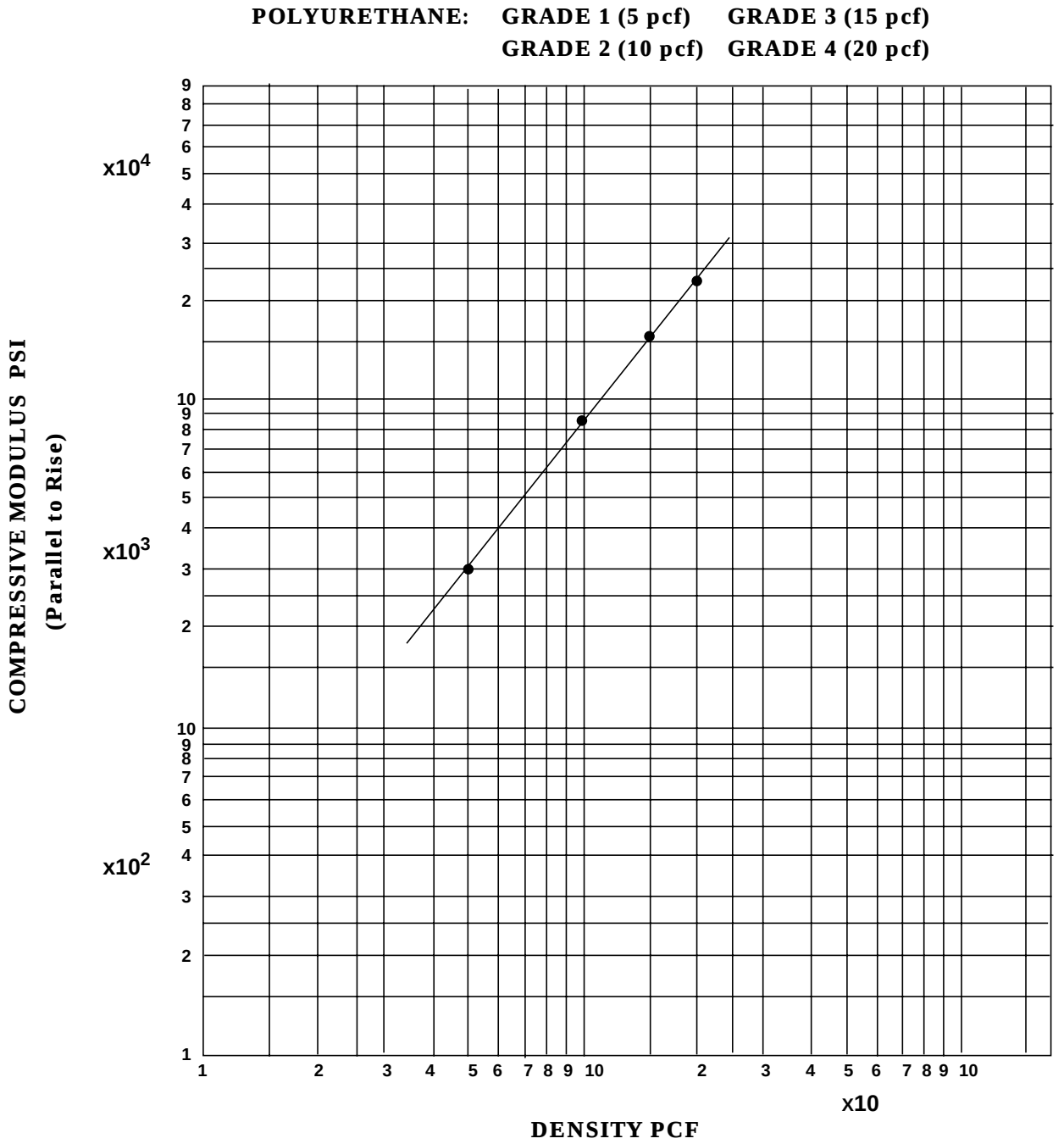

FIGURE 7. MINIMUM COMPRESSIVE MODULUS REQUIREMENTS AT 250^{O}F ± 10^{O}F

POLYURETHANE

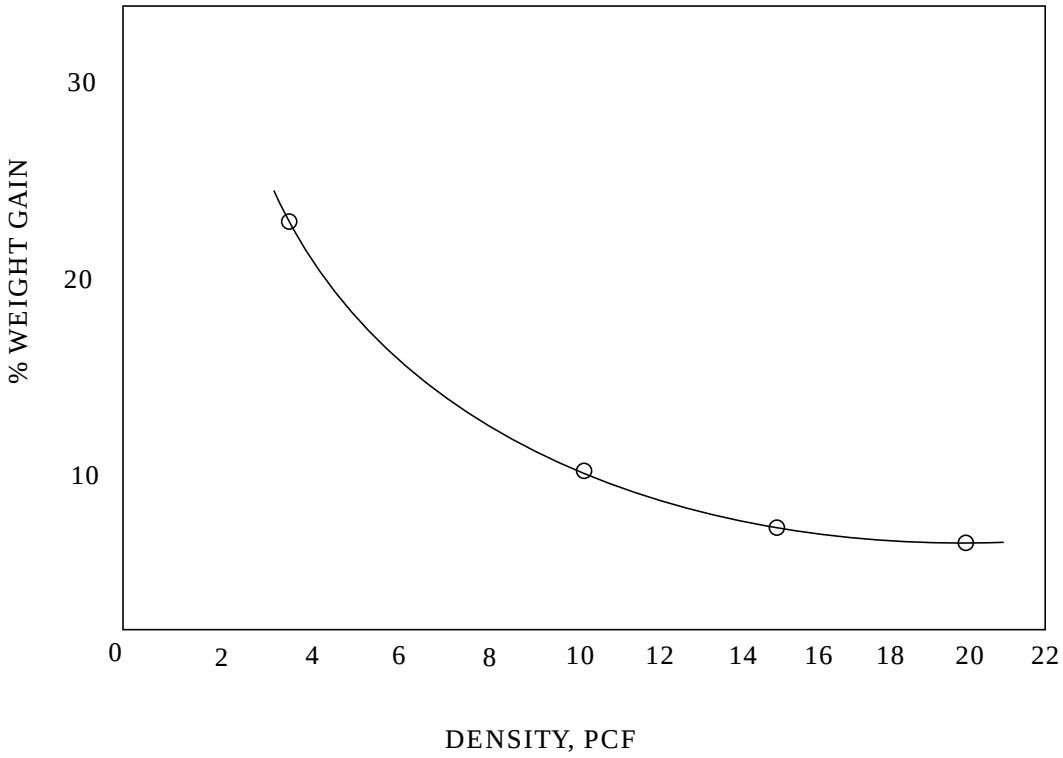

FIGURE 8. **W**ATER ABSORPTION - MAXIMUM ALLOWABLE PERCENT WEIGHT GAIN

QUALIFIED PRODUCTS LIST

MANUFACTURER'S NAME AND ADDRESS	MANUFACTURER'S PRODUCT IDENTIFICATION NO.	DE HAVILLAND QUALIFICATION SHEET NO.	DATE OF PRODUCT APPROVAL
	Grade 1		
General Plastics Mfg. Co. 4910 Burlington Way P.O.Box 9097 Tacoma, Washington 98409 U.S.A. (206) 473-5000	Last-A-Foam, FR-6705	PQS #9	January 26, 1996
	Grade 2		
	Last-A-Foam FR-6710	PQS #10	
	Grade 3		
	Last-A-Foam FR-6715	PQS #11	
	Grade 4		
	Last-A-Foam FR-6720	PQS #12	

BOMBARDIER

de Havilland	Material Specification	DHMS: P 1.29
		ISSUE:
	FOAM RIGID, FIRE RETARDANT	AMD.:
		DATE:
		PAGE: